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Analysis of Architectural Drafting

One hundred copies of a tentative draft of this analysis were submitted to the members of the Illinois Drafting Research Group and to others particularly interested in this field of drawing. Sixty-six copies were returned. All of the learning units were approved, with or without reservations. Units receiving approval by less than 75 per cent were eliminated and all suggested revisions were considered by the committee in formulating the revised analysis presented herewith.

The analysis is the work of the following men: F. G. Elwood, Mooseheart, Ill., Chairman of Subcommittee No. 1; C. I. Carlson, East High School, Aurora, Ill.; Raymond Miller, Western Illinois State Teachers' College, Macomb, Ill.; J. H. Hawkins, Danville High School, Danville, Ill.; R. L. Ready, Batavia High School, Batavia, Ill.; C. B. Allen, J. Sterling Morton High School, Cicero, Ill.; F. J. Renner, Joliet Township High School, Joliet, Ill.

The analysis of architectural drafting presents a problem somewhat different from that of machine drafting. There is a distinct path from the trade of the architectural draftsman to the profession of the architect which does not exist between machine drafting and mechanical engineering. Again, architectural graduates, unlike those in engineering, are required to serve an apprenticeship "on the board" before being allowed to practice. Any analysis of architectural drafting, therefore, must take into consideration both its trade and its professional aspects.

This analysis is the work of Subcommittee No. 1 of the Illinois Drafting Research Committee.

It is not expected that all of the units in this analysis will be taught in any secondary school. It is believed, however, that this analysis can be profitably used in selecting learning units to be taught in achieving the aims of many courses. In general mechanical drawing, for example, only a few units peculiar to the architectural field will be added to the fundamentals needed in all instrumental drawing. More of these units will be selected for that drawing related to the building trades and still more for terminal courses in architectural drafting.

An architectural draftsman, in order to be proficient and to progress in the architectural profession, must know and be able to do the following things and to possess the following related information:

I. THINGS THE STUDENT SHOULD KNOW AND BE ABLE TO DO

A. Fundamentals

1. Select, sharpen, and use appropriate pencils for lettering, dimensioning, and line work in sketching and drawing.
2. Letter notes and titles; space words, phrases, sentences, and titles; make whole numbers and fractions; use appropriate heights of letters and numerals for titles, subtitles, and notes.
3. Know drawing equipment by name and purpose; care for and use it understandingly, viz.: drawing board, T square, triangles, architect's scale, compass, dividers, bow instruments, ruling pen, drop pen, erasing shield, irregular curve, protractor, lettering pen.
4. Place and fasten drawing paper on the board.
5. Lay out standard drawing sheets including border lines and the title strip or block.
6. Use the standard alphabet of lines; visible edge, hidden edge, dimension, extension, reference, break, center, section, and construction.
7. Block out views for proper balance on sheet, at first by measurements; later, approximately by eye.
8. Make projections of views and know their names, locations, and interrelationships in projection.
9. Follow printed directions in applying useful geometrical constructions to drawings of architectural details, such as:
   - *a*) Bisect a line.
   - *b*) Divide a line into a given number of equal parts.
   - *c*) Bisect an angle.
   - *d*) Construct a hexagon, given the distance across the points and across the flats.
   - *e*) Draw an octagon, given the distance across the points, across the flats, or the length of one side.
   - *f*) Divide a circumference into any number of equal parts.
   - *g*) Draw an arc tangent to two straight lines at any given angle.
   - *h*) Draw an arc passing through three given points.
   - *j*) Construct an ellipse by any approximate method and by an accurate method such as the concentric-circles methods.
   - *k*) Construct an approximate semi-ellipse by the five-center method.
10. Make a pencil drawing following an effective order, such as: lay out sheet; block out arrangement and locate views; work out plans, elevations, and details; dimension; letter notes, etc.
11. Dimension drawings to satisfy practical requirements for clearness and utility.

12. Check drawings for clarity, accuracy of dimensions, neatness, specifications, and for form and contrast of lines and general appearance.
13. Make surface developments and intersections of typical sheet-metal forms, such as gutters, downspouts, and skylights. Draw intersections of various types of roof planes, towers, chimneys, etc.
14. Be able to pencil drawings on bond or vellum in an accepted manner so that the technique is good and the prints will be clear and readable.
15. Be able to make inked tracings on bond, vellum, or cloth in an effective order with a technique that will secure a clear print.
16. Erase ink lines or spots with a minimum damage to the surface of the paper or cloth.

B. Symbols

17. Represent building materials in section and elevation using approved symbols as adopted by the A.I.A. or other recognized sources.
18. Use standard symbols in representing doors, windows, etc.
19. Using standard symbols, make a wiring diagram in an approved manner.
20. Use standard symbols in making a plumbing diagram.
21. Use standard symbols in making hot-air, steam, or hot-water heating plans.
22. Use standard symbols for trees, shrubs, etc., in making landscaping plans.

C. Working Drawings

23. Make freehand sketches of floor plans, elevations, sections, and details.
24. Draw common details of construction in wood and masonry.
25. Be able to draw to scale the floor plans, elevations, sections, and details which have previously been sketched in an approved manner so that the technique is good.
26. From definite specifications involving site, orientation, cost, size of family, and social life of owner, design and make complete drawings of residence properly dimensioned and notated.
27. Draw types of buildings, such as store, service and sales garage, and apartment, from definite specifications, and to conform to the building code.
28. Measure doorways, windows, cornices, room sizes, or allotted space for alterations or new equipment.
29. Make notations on drawings so that materials not shown in section are given, and all points not self-explanatory are made clear.
30. Follow drafting-room practice in squad organization, designing, planning, detailing, full-sizing, numbering of drawings and details, filing of drawings and tracings.

D. Engineering Data

31. Be able to use the surveyor's level in establishing excavation and foundation lines, levels, etc.
32. Use handbooks, reference books, catalogs, and data sheets.
33. With the aid of handbooks and data sheets, draw slabs, beams, girders, columns, foundation walls, and footings in steel and reinforced concrete.
34. From given data, draw stress diagrams of simple Howe, Pratt and Fink trusses, determine size of members, and detail the same.
35. Know and be able to draw the most commonly used standard structural shapes and connections.

E. Presentation

36. Make angular and parallel perspective drawings of buildings previously drawn to scale.
37. Know the conventional method of determination and be able to draw outlines of shades and shadows.
38. Be able to render in commonly used media.
39. Be able to do charcoal and pencil sketching from casts, modeling in clay, and model making in various media.
40. Know and draw the five orders of architecture, applying them in modified form to such problems as doorways and entrances.

II. RELATED INFORMATION

A. Technical Information

1. Such knowledge of mathematics and science as is required in designing the structural parts of buildings, as: slabs, beams, girders, lintels, columns, foundations and footings, involving arithmetic, algebra, geometry, trigonometry, physics, and the use of practical formulas in figuring weights, strengths, etc.
2. Know how to use the slide rule.
3. Knowledge of the lumber industry to include sawing, drying, grading, and the relative strength of woods.
4. Know the nominal and actual sizes of lumber. Know the stock sizes of sash, doors, frames, moldings, etc.
5. Some knowledge of paints, lacquers, enamels, and varnishes, and their relation to the life, value, and appearance of buildings.
6. An elementary knowledge of the manufacture of structural steel and its fabrication.
7. A knowledge of the manufacture and use of masonry products, including cement, brick, tile, concrete blocks, gypsum blocks, cinder blocks, terrazzo, art marble, etc.
8. Know the principal bonds used in brickwork and be able to select an appropriate one.
9. A knowledge of the various building stones.
10. Knowledge of the types of insulating materials and how to use them to satisfy acoustical requirements and for weather insulation.
11. A knowledge of the principles and practices of fireproofing and a familiarity with the requirements of the Board of Fire Underwriters.
12. Knowledge of steam, hot-air, and hot-water heating systems, methods of figuring the amount of radiation and sizes of radiators, boilers, vents, registers, pipes, etc.
13. An elementary knowledge of the sources of water supply; the theory of plumbing, the installation of drainage systems, and the disposal of sewage.
14. Principles of illumination; electric lighting, wiring, and equipment.
15. A general knowledge of ventilation and air conditioning.
16. Knowledge of mechanical equipment and installation through acquaintance with catalogs, data sheets, etc.
17. A knowledge of the principles of estimating, and rules for computing quantities of materials.

B. Professional Information

18. Acquaintance with periodicals relating to architecture, drafting, and the building trades.
19. Some knowledge of building codes, contracts, permits, etc.
20. Acquaintance with architects and draftsmen's societies, their aims, activities, qualifications for membership, and dues.
21. Some knowledge of architect's registration laws and requirements for license to practice architecture.
22. An appreciation of the ethical rela-

tionships between the architect and the client, contractor, and society.
23. Knowledge of elementary architectural design and its basic principles; also plan types and other determining factors, such as site, orientation, and style.
24. A knowledge of the history of architecture as a background for present-day architecture.
25. Knowledge of the Beaux-Arts Institute of Design.

C. Miscellaneous

26. How to safeguard sight and general health.
27. Knowledge of the care and use of blueprinting machines and of the reproduction of drawings by means of blueprints, blue-line prints, positive and negative brown prints, etc.
28. Knowledge of the characteristics and uses of such special industrial drafting equipment as lettering devices, parallel rules, parallel attachments, beam compasses, drafting machines, etc.
29. Occupational information; success factors, income, and opportunities.
30. Know how to apply for a job, write a letter of application, importance of good appearance, manners, proper use of English, and dependability.

Constructive criticisms of this analysis will be appreciated. They should be forwarded to Mr. F. G. Elwood, Mooseheart, Ill.

Industrial-Arts Work in the Lower Grades

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The course outline contained in this article was developed by the author for use in the general shop of an academic high school.

The general-shop course of study herein outlined is intended for senior academic high schools — 10th, 11th, and 12th grades — in which students have a choice of pursuing either the college preparatory, the general, or the commercial curriculums. The outline covers two semesters of twenty weeks each or one school year. It is flexible enough to be used whether single, double, or a combination of single and double periods are devoted to the work.

Organization of Subject Matter. The subject matter is divided into six units:

I. Automobile industries
II. Building industries
III. Electricity and electrical industries
IV. Metal-working industries
V. Patternmaking and molding industries
VI. Sheet-metal industries

Each of these units is organized under three main divisions:

I. Objectives
II. Content
III. Bibliography or references

Each division under the content heading is subdivided into:

a) Topics
b) Suggested problems

This general plan has been followed chiefly because of its convenience, simplicity, and adaptability to the problem of constructing and arranging a suitable diversified course of study for academic high schools.

The various units are arbitrarily arranged, since it is best to correlate and unify the industries represented in the course whenever and wherever possible.

The topics listed in each case constitute the basic related and supplementary informational content, while the laboratory problems suggested, illustrate and provide practice in modern manufacturing methods on a modified scale. The designing and making of apparatus, dies, jigs and fixtures, special tools, and the like, to produce some of the articles listed, in order to illustrate modern methods, calls for considerable ingenuity on the teacher's part. In general, approximately 80 per cent of the total time is devoted to practice and 20 per cent to topics or class discussions, tests, and the like.

An attempt has been made to include, as much as possible, articles that are useful and usable. Many other articles can be added or substituted according to the needs, interests, and abilities of the students, and prevailing local or community conditions.

Bibliography. Much excellent reference material for each unit can be found in the books listed. No attempt has been made to list all the possible book references nor any of the visual aids, charts, and other valuable illustrative material that is appropriate and helpful in the teaching of the course.

Methods of Teaching. The subjects of methods of teaching, course organization, student participation, equipment, and the like, have been presented in an article by the writer in the May, 1930, INDUSTRIAL ARTS MAGAZINE under the title "Organizing and Teaching Industrial Mechanics."

Examination. An objective or new-type final examination intended to measure the student's knowledge of industrial mechanics at the completion of the year's work has been devised and is now being evaluated.

Unit I. Automotive Industry

I. *Objectives*
1. To survey the operating principles and functions of the chief units of the modern automobile.
2. To present the essential factors necessary in maintaining and operating the modern automobile.
3. To study the materials, methods, and processes used in modern automobile manufacturing.

II. *Content*
1. Historical and occupational outline of the automobile industry.
a) Topics: (1) Early development of the automobile and modern transportation. (2) Importance of the automobile industry and its effects on social and economic conditions. (3) Facts and figures of the automobile industry. (4) Opportunities and requirements in the industry. (5) Safety and accident prevention.
2. Automobile bodies and chassis
a) Topics: (1) Body construction and materials used — safety-steel bodies and double-drop frames. (2) Body types — closed, open,

roadster, phaeton or touring, convertible cabriolet. (3) Commercial cars, trucks, and taxicabs. (4) Chassis — construction, types, materials. (5) Springs — purpose, parts, types, materials used, location. (6) Front axle — types, purpose, parts, camber, construction.

3. Automobile engines and power plants
   a) Topics: (1) Types. (2) Design and construction, parts and their function, floating power. (3) Principles of operation. (4) Care, maintenance, periodic inspection and adjustments.
   b) Suggested problems: (1) Engine assembly and disassembly. (2) Assigned readings. (3) Class reports and discussions.
4. Cooling, lubricating, and fuel systems
   a) Topics: (1) Direct and indirect cooling systems. (2) Principles of operation. (3) Care, safety, precautions, and antifreeze solutions. (4) Types of lubricating systems and principles of operation. (5) Kinds and specific uses of lubricating oils, greases. (6) Petroleum — distillation and distribution. (7) Function, kinds, operating principles, and parts of fuel systems.
   b) Suggested problems: (1) Assembly and disassembly of various types of carburetors. (2) Reports, questions, and notebook projects. (3) Exhibits.
5. Clutches, transmissions, and brakes
   a) Topics: (1) Types and operating principles of clutches in use. (2) Purpose and and principles of transmission operation. (3) Types in use. (4) Silent synchromesh transmission. (5) Free wheeling. (6) Lubrication. (7) Types, materials used. construction, operation, and adjustment of brakes. (8) Self-energizing brakes.
   b) Suggested problems: (1) Assembly and disassembly. (2) Reading and discussions.
6. Rear axles and differentials
   a) Topics: (1) Types of rear axles and differentials. (2) Purpose. (3) Parts. (4) Design and materials used. (5) Care, adjustment, and lubrication. (6) Types, parts, methods of manufacture, and care of wheels and tires. (7) Rubber and bakelite manufacture.
   b) Suggested problems: (1) Assembly, disassembly, and study of various types of differentials. (2) Class reports and discussions.
7. Automobile troubles and remedies
   a) Topics: (1) Power-plant troubles — mechanical and electrical. (2) Transmission troubles. (3) Chassis troubles. (4) Correct operation and periodic inspection, overhauling, care, driving rules and regulations.
8. Manufacturing processes
   a) Topics: Processes of drop forging, die casting, molding, welding, quantity production, progressive assembly, metal plating and inspection, applied to modern automobile manufacturing.

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Unit II. Building Industries

I. *Objectives*

1. To teach the principles and best practices in use in modern home and building construction.
2. To study and apply some basic related knowledge of materials and operations in fields related to the building industries.

II. *Content*

1. Historical and occupational outline of the building industries
   a) Topics: (1) Kinds of ancient and modern buildings.
2. The lumber industry and lumbering
   a) Topics: (1) Felling, logging, sawing, transportation, forests, and reforestation, millwork. (2) Lumber classification and grading. (3) Properties, uses, and identification of lumber. (4) Terminology used. (5) Seasoning. (6) Preservation. (7) Distillation. (8) Veneering. (9) Paper-making. (10) Wood Testing. (11) Opportunities and requirements in the industry.
   b) Suggested problems: (1) Identification of common woods. (2) Billing. (3) Estimating and specifications. (4) Testing Woods.
3. Hand and machine tools used in building industries
   a) Topics: (1) Description and purpose of the most

important machine and tools in use. (2) Sharpening and care of hand tools. (3) Demonstrations and best methods of approach to problems — laying out, sawing, planing, assembling.

b) Suggested problems (1) Sharpening knives, chisels, plane irons, and the like.

4. Masonry materials and operations
   a) Topics: (1) Description of common materials and their manufacture and use in masonry. (2) Building stones. (3) Brick and Tile. (4) Asphalt. (5) Repairs and improvements.
   b) Suggested problems: Cement steppingstone, bird bath, flower pot, etc.
5. Carpentry materials and operations
   a) Topics: (1) Description and explanation of carpentry materials, operations, tools, and terminology. (2) Use and manufacture of insulating materials. (3) Weatherproofing. (4) Repairs and improvements. (5) Doors and windows.
   b) Suggested problems: (1) Laying out a garage. (2) Plumbing or leveling a timber. (3) Rafter cutting.
6. Plastering materials and operations
   a) Topics: (1) Preparation for lathing. (2) Lathing materials. (3) Plaster, lime, cement, and concrete. (4) Terra cotta and sanitary ware. (5) Repairs and improvements in the house and its equipment.
7. Plumbing and heating
   a) Topics: (1) Water connection and sewer. (2) Traps and vents. (3) Care and repair of plumbing. (4) Freezing. (5) Stoppage. (6) Inspection. (7) Heating systems. (8) Manufacture and use of asbestos. (9) Fuels — coal, coke, oil. (10) Repairs and improvements.
   b) Suggested problems: Pipe cutting, threading, and fitting.
8. Paints, varnishes, and stains.
   a) Topics: (1) Paints and painting. (2) Finishing materials — stains, varnishes, enamels, lacquers, turpentine. (3) Care of brushes.
   b) Suggested problems: Finishing and refinishing furniture and other articles made in the course.
9. Gas manufacture
   a) Topics: (1) Historical outline of gas manufacture. (2) Manufacture and use of gas.
10. Window and plate-glass manufacturing
    a) Topics: (1) Ancient and modern methods of glass manufacture. (2) Sizes and weights of glass. (3) Qualities and grades of glass.
    b) Suggested problems: Cutting glass and glazing windows.

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Unit III. Electricity and the Electrical Industries

I. *Objectives*

1. To teach some of the fundamental principles and laws of electricity through laboratory problems, projects, and experimentation.
2. To study the essential and useful related knowledge regarding the electrical power and construction industries — their history, processes, and products.

II. *Content*

1. Historical and occupational sketch of the electrical industries
   a) Topics: (1) Important scientific discoveries in the field of electricity. (2) Distinguished scientists and their careers. (3) Typical present-day organization and methods of production. (4) How electricity is made and distributed. (5) Power stations and substations. (6) Hydroelectric power. (7) Opportunities and requirements in the electrical industries. (8) Safety and accident prevention.
   b) Suggested problems: Assigned topics; illustrated notebooks; class discussions.
2. Magnetism, magnets, and magnetic induction
   a) Topics: (1) The lodestone. (2) Poles — law of action. (3) Permanent magnets and electromagnets. (4) Magnetic field of force. (5) The compass and how it works. (6) Magnetic and nonmagnetic substances. (7) Induced magnetism. (8) Experiments showing the nature of magnetism. (9) The principle of magnetic induction and its importance in the electrical industry.
   b) Suggested problems: (1) To make a magnet. (2) To make a compass. (3) To determine magnetic substances. (4) To show

that unlike poles attract and like poles repel. (5) Experiments with kinds of magnets. (6) Induction experiments — (*a*) stationary flux and a moving conductor; (*b*) stationary wire and moving flux.

3. Nature of electricity and electric current
   a) Topics: (1) Methods of generating electric current and the nature of current — chemical and mechanical. (2) Names and characteristics of common electrical materials. (3) Meaning and understanding of the terms — volt, ampere, ohm, e.m.f. (4) Ohm's Law. (5) Right-hand rule. (6) Dry cells — their construction, use, and connections. (7) Storage batteries — their manufacture, construction, care, and maintenance. (8) Electrical conductors and insulators.
   b) Suggested problems: (1) Producing an electric current by various methods. (2) Making a galvanic cell. (3) Testing materials for conductivity. (4) Making and charging a simple storage cell. (5) Determining a.c. or d.c. current and direction of flow. (6) Figuring amperage, voltage, length of wire needed for problems and experiments in the course. (7) Parallel, series, and multiple connections.
4. Electric power, lighting, and heating
   a) Topics: (1) Hydraulic analogy. (2) Meaning and understanding of the terms — watt, kilowatt, horsepower, kilowatt-hour. (3) Resistance and friction. (4) Power wasted in heating conductors. (5) Safe carrying capacity of wires. (6) Protection by fuses, circuit breakers, etc. (7) Resistance and arc furnaces. (8) Electric welding. (9) Pyrometers. (10) Street lighting. (11) Carbon filament, metal filament, and tungsten lamp manufacturing processes.
   b) Suggested problems: (1) Figuring watts consumed by electric toasters, ironers, radios, electric refrigerators, heaters, vacuum cleaners, electric lights, and the like. (2) To make an electric heater.
5. Electric circuits
   a) Topics: (1) Voltage, current, and resistance of series and parallel circuits. (2) Various electric-lighting circuits and their loads. (3) Bell circuits. (4) Principle on which electric bells and buzzers work. (5) Switches and sockets. (6) Symbols in circuit diagrams.
   b) Suggested problems: (1) To connect a single bell circuit. (2) Front and rear systems. (3) Bells in series and parallel. (4) Three-wire return call. (5) Two-wire with ground return. (6) Calculating current, pressure, and resistance in single, series, and parallel loads. (7) Installing a bell transformer.
6. Electrical devices
   a) Topics: (1) Manufacture, construction, purpose, and use of rheostats, circuit breakers, rectifiers, condensers, arresters, transformers, annunciators, alarms, automatic starters, and the like. (2) Theory of transformer operation. (3) Importance of transformers in power transmissions. (4) Parts of a transformer and their functions.
   b) Suggested problems: (1) To construct a transformer and test its efficiency.
7. The electric motor and dynamo
   a) Topics: (1) Names and functions of the essential parts of an electric motor. (2) Principles of operation.
   b) Suggested problems: (1) To construct a small electric motor that will operate satisfactorily.
8. Automobile starting, lighting, and ignition
   a) Topics: (1) Function of the starter, generator, battery, magneto, induction coil, distributor, condenser, and spark plug. (2) Principles of operation. (3) Care, adjustments, and replacements.
   b) Suggested problems: (1) To construct and study a model or actual automobile ignition system. (2) Study of wiring diagrams.
9. Electricity in the home
   a) Topics: (1) Dangers and precautions in handling electricity and electrical apparatus. (2) Fuses and their purpose. (3) Short circuits and overloaded circuits. (4) Reading watt-hour meters. (5) Electric lighting and heating. (6) Electric refrigeration. (7) Automatic oil heating. (8) Electric ironers, radios, and other electrical appurtenances. (9) House wiring. (10) National code.
   b) Suggested problems: (1) To figure loads on wires and determine safety factor. (2) Reading watt-hour meters. (3) Test for short circuit. (4) Repair an electrical appliance or extension cord. (5) Testing and replacing fuses. (6) Wiring a two-receptacle lamp.
10. Electrical measurements and measuring instruments
    a) Topics: (1) Principle of the galvanometer and its uses. (2) Ammeters and meters — their construction and use. (3) Watt meters and watt-hour meters — their purpose and use. (4) Measurement of resistance. (5) Calibration of instruments. (6) Other important electrical measuring instruments.
    b) Suggested problems: Problems involving the purpose, reading, and use of various electrical measuring instruments.

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Unit IV. Metal-Working Industries

A. BENCH METAL WORK
B. USE OF JIGS AND FIXTURES
C. ELEMENTARY METALLURGY
D. MACHINE-TOOL OPERATION

I. *Objectives*

1. To teach the operation and care of some common standard machine and hand tools.
2. To provide practice in, and acquaintance with, some modern basic manufacturing methods of production.
3. To teach some of the modern methods and principles of the heat treatment of metals.
4. To survey and study some basic modern manufacturing methods and some basic processes, materials, tools, organization and management.

II. *Content*

1. Historical and occupational sketch of the metal manufacturing industries
   a) Topics: (1) Social and economic background. (2) Craftsman guilds and apprenticeship. (3) Modern interchangeable manufacturing and quantity production methods. (4) Organization and management of the modern factory system — executive and managerial positions, semiskilled, skilled, and highly skilled workers. (5) Safety and accident prevention. (6) Opportunities and requirements of the metal-manufacturing industries.
2. Manufacture of iron and steel
   a) Topics: (1) Historical sketch. (2) Iron ores. (3) Smelting. (4) Bessemer, open-hearth, cementation, crucible, and electric processes. (5) Charcoal, iron, and wrought iron. (6) Cast steel, alloy steel, cast iron, malleable iron. (7) Rolling mills and rolling.
3. Drop forging
   a) Topics: (1) Importance and extent of drop forging in present-day manufacturing. (2) Drop-forging dies and their use. (3) The drop-forging process. (4) Examples and illustrations of drop-forged articles.
   b) Suggested problems: Identification and evaluation of drop-forged articles and parts in daily use.
4. Die casting
   a) Topics: (1) Brief historical outline. (2) The die-casting process. (3) Metals used in die casting. (4) Die-casting dies. (5) Examples of die-cast products.
   b) Suggested problems: (1) Aluminum-handled screw driver. (2) Aluminum-handled knife. (3) Lead hammers. (4) Identification of die castings.
5. Jigs and fixtures
   a) Topics: (1) Definition and purpose of jigs and fixtures. (2) Types of jigs and fixtures. (3) Design of jigs and fixtures. (4) Cost of jigs and fixtures.
   b) Suggested problems: (1) Wrought-iron lamps. (2) Wrought-iron magazine holders. (3) Hand hacksaw frames. (4) Electric toasters.
6. Welding
   a) Topics: (1) Ancient and modern welding processes — autogenous welding, flash welding, spot welding, arc welding, and the like. (2) Welding apparatus and welding machines. (3) Present importance and place of welding in industry. (4) Examples of welding. (5) Arc furnaces. (6) Pyrometers and their use.
   b) Suggested problems: (1) School exhibit, display panel, or illustrated notebook on welding. (2) Wrought-iron fern stand. (3) Wrought-iron table stand. (4) Wrought-iron table lamp.
7. Modern machine tools
   a) Topics: (1) Development of the modern machine tool. (2) Automatic and semiautomatic machines. (3) Special machines. (4) General description of design, operation, and purpose of several standard machine tools in daily use. (5) Lathes and lathe work. (6) Drills and drilling. (7) Milling machines and milling. (8) Grinding and abrasives. (9) Shaper and planer work. (10) Screw-machine products. (11) Mandrel and arbor presses. (12) Grinding and sharpening cutting tools. (13) Care of tools and machines. (14) Methods of approach to problems. (15) Safety and accident prevention. (16) Measuring tools and gauges in use.
   b) Suggested problems: (1) Sharpening tools, bits, drills, chisels, and the like. (2) Screw drivers. (3) Wood and metal lathe centers. (4) Bench stops. (5) Small grinder. (6) Small electric motor. (7) Gear blanks. (8) Bench blocks. (9) Chuck keys. (10) Lathe mandrels. (11) Plug and ring gauges. (12) Reamer blanks. (13) Sleeves. (14) Cutter blanks. (15) Bolts. (16) Machine parts.
8. Elementary metallurgy
   a) Topics: (1) Important properties and characteristics possessed by the common metals. (2) Distinguishing characteristics of the most common metals in daily use. (3) Heat treatment of metals and heat-treating processes. (4) Types of heating furnaces. (5) Hardness and strength tests. (6) Tests for distinguishing metals. (7) Advent of high-speed and stainless steels.
   b) Suggested problems: (1)

Identification of metals in common use. (2) Hardening, tempering, and case-hardening of problems listed under No. 7 above. (3) Forging of screw-driver bits, cold chisels, center punches, and the like. (4) Twisting, bending, and shaping hot and cold metal. (5) Testing metals for hardness, strength, and the like.

9. Inspection and assembling
   a) Topics: (1) Necessity for, and methods of, inspection. (2) Gauges and gauging systems. (3) Precision limits and allowances. (4) Assembling methods — unit and progressive assembly. (5) Fits and fitting.
   b) Suggested problems: Written topics on inspection and assembling; assembling and inspection of problems listed above.
10. Rust-prevention processes and protective metallic coatings
   a) Topics: (1) Kinds of coatings used. (2) Modern methods — preliminary and final processes. (3) Equipment and apparatus used. (4) Advantages of protective coatings. (5) Tests for protective coatings. (6) Shop chemistry.
   b) Suggested problems: Chrome plating of articles made in the course.
11. Industrial inventions and inventors
   a) Topics: (1) Discussions of important industrial inventions such as the milling machine, lathe, compressed air, sand blasting, puddling furnace, stainless steel, and the like. (2) Distinguished industrial inventors and their careers. (3) Effects of inventions on social and economic conditions.
   b) Suggested problems: Written assignments and discussions on inventors and inventions.
12. Benchwork in metal
   a) Topics: (1) Laying out methods, tools, and materials used. (2) Chipping and use of chisels. (3) Files, filing, and polishing. (4) Modern file manufacture. (5) Hack saws and their use. (6) Screw-thread systems — use of taps and dies. (7) Reamers and reaming. (8) Scrapers and scraping. (9) Names and uses of tools.
   b) Suggested problems: (1) Drill drifts. (2) Wrenches. (3) Bench stops. (4) Calipers. (5) Hack-saw frames. (6) Problems involving fitting and assembling. (7) Problems involving the use of jigs, fixtures, bending and forming devices. (8) Machine repair parts. (9) Wrought-iron problems. (10) Inspection of finished parts.

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Unit V. Patternmaking and Molding Industries

I. *Objectives*

1. To review and extend the teaching of the basic principles involved in wood and metal pattern construction.
2. To teach the principles and practices involved in molding patterns and producing castings.
3. To apply the principles and practices of wood turning chiefly to the making of wooden patterns.
4. To survey and study the basic methods, materials, and manufacturing processes related to patternmaking, molding, and wood turning.

II. *Content*

1. Historical and occupational sketch of the patternmaking and molding industries.
   a) Topics: (1) Rise and development of the patternmaking and molding industries. (2) Role of the patternmaker and molder. (3) Present-day plan organization and methods of production. (4) Relation to metal-working industries. (5) Opportunities and requirements in the patternmaking and molding industries.
   b) Suggested problems: Exhibits and illustrated notebooks.
2. Wood and metal pattern construction
   a) Topics: (1) Kinds of patterns and their construction. (2) Meaning and use of cores, core prints, and core boxes. (3) Necessity and use of layout drawings, draft, shrinkage, finish allowances and fillets. (4) Machine and hand tools used in patternmaking. (5) Sharpening and care of hand tools. (6) Pattern woods. (7) Shrinking, swelling, and warping of wood.

b) Suggested problems: (1) Angle plates. (2) Grinder parts. (3) Bracket. (4) Toolrest. (5) Candleholder. (6) Book ends.

3. Molding and foundry practice
   a) Topics: (1) Raw materials used in molding and foundry work. (2) Characteristics of molding sand, core sand, and parting sands. (3) Facings — their purpose and use. (4) Molding methods and processes. (5) Core manufacture. (6) Molding machines. (7) Nomenclature, terms, and tools used in molding practice. (8) Standard procedure in molding patterns. (9) Melting and mixing metals. (10) Aluminum. (11) Charcoal and coke.
   b) Suggested problems: (1) All patterns should be rammed up and the mold inspected before patterns are accepted for credit. The most needed patterns can be molded. (2) Problems suggested in 2*b* above and others.
4. Wood turning
   a) Topics: (1) Centering stock. (2) Machine adjustments and care. (3) Names and uses of tools. (4) Wood-turning operations. (5) Faceplate work. (6) Distinguishing characteristics of common woods used in wood turning. (7) Methods used in industry. (8) Sharpening and care of wood-turning tools.
   b) Suggested problems: (1) Wood lathe faceplates. (2) Rosette chucks. (3) Candleholders. (4) Pulleys. (5) Grinder patterns. (6) File handles. (7) Chisel handles. (8) Mallets. (9) Sash weights. (10) Gear blanks.

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Unit VI. The Sheet-Metal Industry

I. *Objectives*

1. To extend the teaching of the operation and care of some of the standard tools and machines in use in the sheet-metal industry.
2. To study and apply where possible the basic related knowledge of materials, processes, and methods of manufacture.

II. *Content*

1. Historical and occupational sketch of the sheet-metal industry.
   a) Topics: (1) Old-time copper and tinsmith. (2) Modern sheet-metal shop. (3) Extent and use of sheet iron and sheet steel. (4) Sheet-metal products. (5) Occupations. (6) Safety and accident prevention. (7) Opportunities and requirements in the industry.
2. Manufacture and characteristics of various sheet metals and nonferrous alloys.
   a) Topics: (1) Rolling of sheet metal. (2) Protective coatings, lacquers, paints. (3) Tin plate. (4) Terne plate. (5) Black iron. (6) Allegheny iron. (7) Galvanized iron. (8) Monel metal. (9) Copper. (10) Lead. (11) Zinc. (12) Gauges and gauging systems.
   b) Suggested problems: Identification and selection of the most suitable materials for various types of work.
3. Sheet metal in building and other industries.
   a) Topics: (1) Standard practice in sheet-metal work. (2) Roofing, gutters, and conductors. (3) Flashings and corrugated iron work. (4) Skylights and ventilators. (5) Metal cornices. (6) Metal ceilings. (7) Warm-air furnaces. (8) Heating and ventilating systems. (9) Blowpipe and exhaust systems. (10) Metal doors, windows, and trim. (11) Restaurant, kitchen, hotel, and school equipment. (12) Furniture. (13) Automobile and airplane work. (14) Heavy gauge work.
   b) Suggested problems:
      (1) Square-to-square fitting on air vent
         (*a*) Material: 28-gauge galvanized iron.
         (*b*) Processes: Triangulation development for pattern, laying out, cutting, grooving, forming.
      (2) Furnace boot
         (*a*) Material: Tin plate
         (*b*) Processes: Triangulation, laying out, braking, cutting, forming, seaming.
      (3) Molded roof gutter (cornice)
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Drafting, layout, cutting, forming, braking, soldering, bracing, riveting.
      (4) Steam radiator cover
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Layout, cutting, seaming, forming, soldering.
      (5) Window ventilator
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Layout, cutting, seaming, forming.
      (6) Radiator humidifier
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Layout, cutting, forming, soldering.
   c) Suggested supplementary problems: (1) Square-to-rectangular fitting on air vent. (2) Square-to-round on ventilator fitting. (3)

Eave-trough gutters. (4) Square return miter or Roman molding on cornice work. (5) T-like diameter. (6) Roof flange. (7) Two-piece 90° elbow. (8) Y-like diameter. (9) Short-piece gutter.

4. Basic bench and machine processes
   a) Topics: (1) Folding, (2) Forming, (3) Grooving, (4) Burring, (5) Edging, (6) Turning, (7) Wiring, (8) Seaming, (9) Crimping, (10) Swaging, (11) Beading, (12) Cutting, (13) Setting down, (14) Double seaming, (15) Breaking, (16) Circular cutting, (17) Slitting, (18) Punching, (19) Stamping, (20) Bending, (21) Shearing, (22) Rolling, (23) Machining.
   b) Suggested problems:
      (1) Megaphone
         (*a*) Material: Tin plate
         (*b*) Processes: Radial development of pattern, notching, forming, grooving, turning, wiring, peening, soldering.
      (2) Dustpan
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Developing and using pattern, cutting, folding, seaming, soldering, drilling, riveting.
      (3) Oil measure and funnel
         (*a*) Material: 28-gauge galvanized iron
         (*b*) Processes: Radial line development, forming, grooving, seaming, turning, soldering.
   c) Suggested supplementary problems: (1) Drawer. (2) Supply box. (3) Toaster. (4) Oil measure. (5) Fruit-jar filler. (6) Mail box. (7) Tin cup, double seamed.
5. Solders and soldering
   a) Topics: (1) Definitions. (2) Soft solder and equipment. (3) Fluxes. (4) Tinning. (5) Soldering process. (6) Brazing.
   b) Suggested problems: Applied to problems throughout the course.
6. Basic layout methods
   a) Topics: (1) Rectangular work. (2) Parallel-line development. (3) Radial development. (4) Triangulation. (5) Approximate.
   b) Suggested problems: These basic methods are applied to the problems throughout the course.
7. Metal spinning
   a) Topics: (1) Metal spinning in industry. (2) Tools used. (3) Materials used. (4) The spinning operation.
   b) Suggested problems: (1) Card tray. (2) Fruit dish. (3) Ash tray.
8. Punch presses — their function and use
   a) Topics: (1) Importance and significance of press-work. (2) Advantages. (3) Design and operation of presses and subpresses. (4) Blanking dies. (5) Drawing dies. (6) Bending and forming dies. (7) Examples of stamped and pressed work.

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Analysis of Senior-High-School Mechanical-Drawing Texts

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This study is a part of a master's thesis on the content of senior-high-school drawing (excluding art drawing), University of Wichita, 1933.

This analysis was made in order to determine the nature and character of the content of drawing textbooks that are used in grades 10, 11, and 12 of the senior high schools at the present time.

A second purpose was to determine criteria for the selection of textbooks for senior-high-school use. A third purpose was to indicate the degree to which the authors consider certain content important. This information was then used with other factors in the con-

struction of the drawing curriculum at High School East.

A study of bibliographies of drawing textbooks showed that 36 firms publish books of this type. Correspondence was conducted with these companies and the following data were requested: Titles of texts for use in senior high schools; the names of the authors of these texts; the number of schools using each text; the number of copies published to date; the date first published; the date of the latest revision; and the retail price. Each of the 36 publishing houses replied. Of these, 28 published textbooks on drawing for high schools. These 28 books were obtained either from my private library, the Wichita High School East library, or from the publishers. Twenty-two were found to be designed for use as textbooks in the senior high school. For four-year high schools the ninth grade was included. The individual author's statement of the purpose of each textbook was taken as the basis for the selection of the texts for the study. Textbooks that are commonly known as *Mechanical* drawing texts only have been used, because that type of drawing is more in use in high schools than all other classifications of drawing combined. Those textbooks which were of a general nature were studied rather than the special types, because the courses in drawing that are taught in the industrial department[1] of the Wichita high schools are intended to be general informational and broadening courses, rather than the specialized work of a vocational school.

In each textbook there appeared a grouping of content under certain heads. These were tabulated for the 22 texts that were analyzed. See Table I and Figure 1.

The following is a brief description showing how the topics were interpreted and recorded. Those topics that are not discussed here were taken to be sufficiently clear as to not warrant it.

Developments and intersections was taken to include only that work which attempted to teach merely the fundamentals of that subject, while *sheet-metal drawing* was interpreted as being the practical application of a specific part of *development and intersections.*

Orthographic projection and working drawings were taken to include the fundamentals of orthographic projection (with all special views) and working drawings, while *machine drawing* was interpreted to be the specialized work of a machine draftsman.

Practice and conventions are two closely related topics. Practice was interpreted as that subject matter and problems which offered the student the opportunity for practice in securing the proper technic in drafting, while the use and care of drafting equipment, dealt only with teaching the intended use of, and the proper care of the drafting equipment. Conventions are the standard symbols which are employed in drafting, and was considered to be coupled with practice so closely that the two could not be separated.

None of the texts included all of the topics; however, the recorded divisions proved to be the topics contained in the textbooks that were analyzed. The space allotted to the tables of contents, prefaces, margins, appendices, indexes, and other material not bearing directly on the subject matter was not given consideration in this study.

In all cases where the content of a text was broken up or scattered throughout the book, each page was counted and tabulated in the different categories listed in the table and in the graph. Fractional pages were not recorded until the sum of these fractional parts totaled a whole page. All textbooks that were not printed in ten-point type were transposed to that basis. No attempt was made to distinguish between the different styles of the faces of the type

[1]There is also the vocational department which offers machine and architectural drawing under the terms of the Federal Smith-Hughes Law. This type of drawing was not considered in this study.

TABLE I Drawing textbooks used in high schools. Per cent of space alloted to each topic mentioned

No. of textbooks	Total square inches of content in textbook	Applied geometry	Architectural drawing	Charts, diagrams, graphs and tables	Developments and intersections	Electrical drawing	Equipment. Its use and care	Estimating weights, materials, stresses	Furniture drawing and design	Lettering	Machine drawing	Map and topographical drawing	Mensuration	Orthographic projection and working drawing	Patent-office drawing	Perspective	Pictorial representation (other than perspective)	Piping and pipe drawing	Practice and conventions	Shading	Sheet-metal drawing	Sketching	Structural drawing
No. 1	3648	28.1			13.2		16.5			1.3	10.0	2.0		18.4			8.5		2.5	2.5			
2	2448	3.0			28.5		1.9			1.9				55.9			3.9		4.9				
3	6372	7.1	5.5		15.8		4.9			3.2	5.5			50.6			1.9		5.5				
4	6048	2.1	1.0		6.2		5.2				17.9			52.0			4.1		9.4			2.1	
5	3850	7.8	9.8				9.8			2.6	33.7			23.4			5.8		1.9			6.2	
6	6110	3.8	13.3		18.6		2.7			2.7	22.3			19.0			6.4		4.8		5.3		1.1
7	6678	4.4	4.9		12.3		5.4			3.8	21.0			29.6		1.0	9.0		5.6			3.0	
8	9380	3.0			1.6		13.5				17.7			16.5		1.9	1.2		39.0	0.8		4.8	
9	5488	17.4	0.5		13.2		11.2			10.8	1.6			21.9			13.2		9.2	1.0			
10	7950	3.7	4.1		7.2		4.1		2.5	15.7	12.6			8.2		18.0	4.4		9.4			10.1	
11	5591	2.5	20.2	3.1	2.2	3.3	5.0		4.2	3.3	19.6	6.6		10.2	1.7	1.6	3.3		3.3		3.3	2.2	4.4
12	2366				5.9		1.2			1.2	24.7			47.8			4.8		14.4				
13	5157				13.6		8.4			1.0	21.0			49.7					6.3				
14	4340				8.0		12.7			12.7				33.0		11.2	14.4		8.0				
15	2064	1.2			15.8		7.2			4.7	41.0			23.0			4.7					2.4	
16	5832	17.6			16.7		2.8			4.7	24.9			19.4		5.6	5.6		1.8	0.9			
17	12580	5.7	20.7		1.7		0.8			4.5	27.3			19.2		13.4	1.5		0.3	3.2		1.7	
18	5320	9.5			10.0		3.9	7.9		3.1	24.3			20.6	0.5		4.5	2.3	7.6	2.1		3.7	
19	5832	2.7			7.4		13.8				0.9			46.5		8.3	10.2		3.7	6.5			
20	7776	10.4		0.6	7.6		9.1			6.2	11.8			28.0			8.3		12.5			5.5	
21	6440	16.3					15.0			3.0			10.8	34.3					10.8	3.4		6.4	
22	3010	7.4	6.1	3.8	8.4	2.3	8.8			2.3	8.4	9.3		19.1			2.8		18.1			3.2	
23	13689	5.4	8.4	3.0	11.6	2.6	4.2			5.7	11.3			17.4		4.0	9.8	3.2	8.0	2.7		2.7	
Average for texts		6.8	4.1	0.5	9.8	0.4	7.3	0.3	0.3	4.1	15.5	0.8	0.5	29.2	0.1	2.8	5.6	0.2	8.1	0.7	0.4	2.3	0.2

as that difference is of such little moment as to vitiate the results.

The pages of the textbooks were of varying sizes; and only the body of the printed matter and the borders of the plates were considered as governing the content of a page in computing and tabulating the number of square inches of subject matter in each of the topics.

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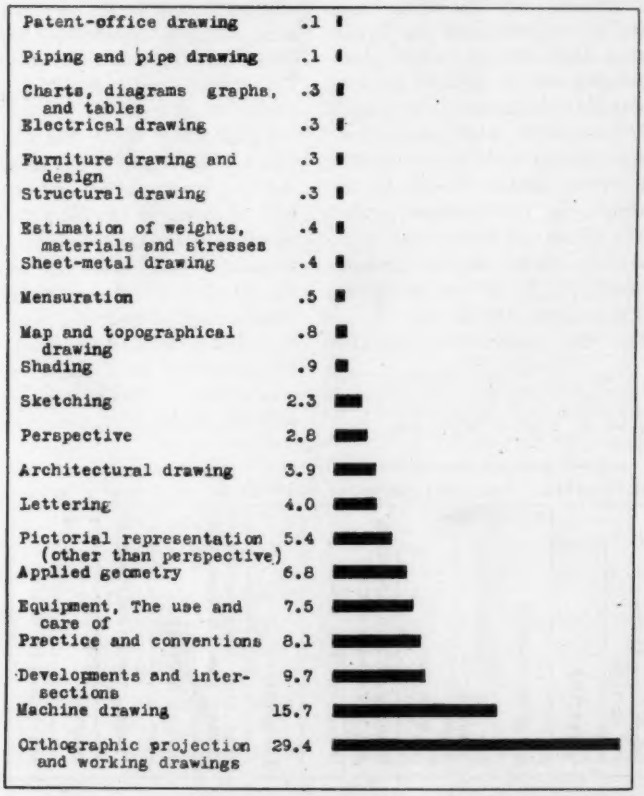

Fig. 1. Per cent of space allotted to the several topics in drawing textbooks for use in the senior high school

The space allotment of the topics in drawing textbooks is shown in Table I.

The questionnaires showed that text No. 7 was used more than any other, and that No. 6 was the next most popular textbook for high-school use. The textbook that was the nearest to the average per cent of space allotted to the several topics was No. 11.

The space allotment to the several topics may not be a good criterion by which to judge the quality and the value of drawing textbooks, yet it does indicate to some extent the degree to which each author held the topic important. It may also show the individual author's major emphasis, methods, and training. The average for all of these texts will minimize the discrepancy

[2]The numbers which appear opposite the titles of the texts are the numbers opposite which these texts appear in the accompanying table.

[3]These texts were published after this study was made and is listed separate from the compilation and average of the texts used. They are recorded on the same basis as the other texts so a comparison can be made.

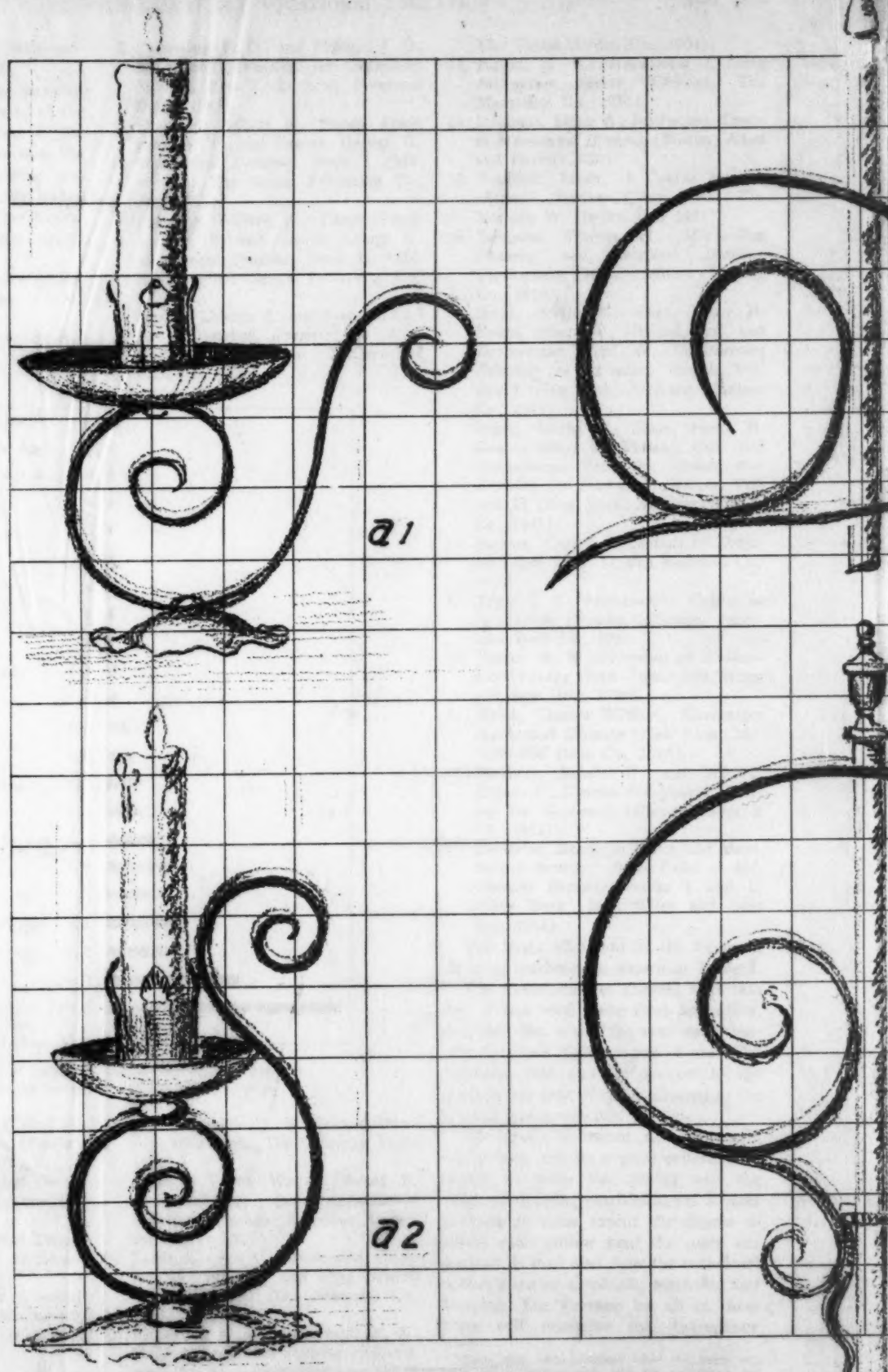

Chart VI — Artistic Wrought-Iron Work, by C. Weiler and Karl Ufer, New York City. (Described elsewhere in this issue)

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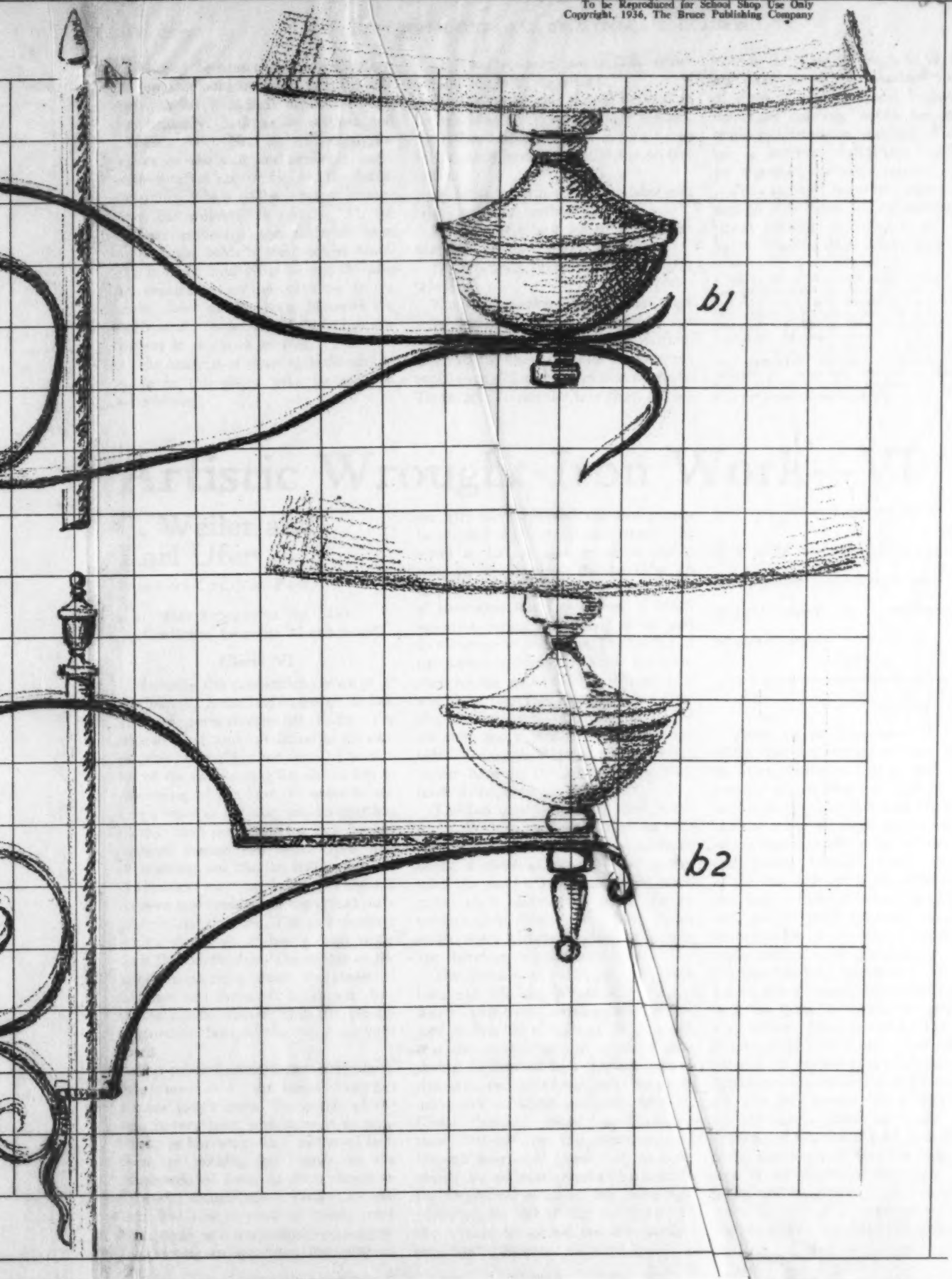


which may be present in the evaluation.

Few textbooks analyzed in this study have shown a radical departure from the ordinary, both as to method and content. Text No. 23 organized the topics on the unit and semester basis, with detailed instruction for the learning units, which is the greatest change from the ordinary. In text No. 11, the authors presented the material from most of the fields of work where drawing is used; and Nos. 13 and 14 also are constructed on the unit plan. In the main, most of the texts followed the traditional form established by the leaders in textbook writing.

The analysis of drawing textbooks as made in this study may be used in determining:

a) What topics of "mechanical" drawing are the most important.

b) The topics that should be used in the teaching of drawing in high schools.

c) The amount of time to be allotted to the study and drawing in the several topics.

d) Criteria with which to judge and select drawing textbooks.

e) The texts best suited for use as textbooks in the class.

f) The texts best suited for use as reference.

This analysis also indicated that there were several excellent textbooks on "mechanical" drawing on the market, and each of these excelled in the presentation of different topics and methods. To be able to use the best from all, we have in the drawing library in the drafting room about two hundred volumes of drawing and technical books; and numerous catalogs which we use as texts and reference material. Also, we use a mechanical-drafting handbook[4] for standard drafting practice.

This analysis with two nation-wide[5] surveys was used in determining the course content of "mechanical" drawing at Wichita High School East.

[4]Brown, Dewey Wheeler, *Mechanical Drafting Handbook* (Wichita: Blueprint form, 125 pages, 1933).

[5]1. The Nature and Amount of the Content of Senior-High-School Drawing in Cities of Seventy-Five Thousand to Two Hundred Fifty-Two Thousand Population (eighty-one cities).

2. The Nature and Amount of the Content of Senior-High-School Drawing as Recommended by Professors of Engineering Drawing in Schools of Engineering, which have an enrollment of four hundred and above (fifty-five schools).

Artistic Wrought-Iron Work—VI

C. Weiler and Karl Ufer

New York City, New York

(See Supplement No. 325)
(Continued from the March issue)

The sixth and last of this series of articles on the design and techniques used in working with wrought iron.

Chart VI

Basically the candlestick shown at a^1 in Chart VI is not bad in design. It has, however, several essential faults. The base in itself, and in relation to the candle drip, is entirely too small. The center of the candle drip lies to the left of the center of the base. In order to obtain a sense of balance, the designer has carried the S curve, serving as a handle, outward toward the right. Upon first observation, one has the feeling that the candlestick may topple over. This will be even more evident in the actual piece than in the drawing. The more correct design shown at a^2 has a base larger than the candle drip. The center of the candle is straight above the center of the base and the scroll is brought close to the candle. Notice that the general proportion lies within a pyramided shape.

The pointed ends of the bridge-lamp arm shown at b^1, are splendid catches for our lady's dress. The design of the arm is very poor, and there is no semblance of harmony. As a matter of fact, there is nothing but clash in the counterrelated lines. At b^2 is shown an improved design which brings out the fact that design must be based more often than not on geometrical figures. By drawing an imaginary line continuous with the horizontal, this design may be divided into the following units: the scroll at left, a quarter circle and a triangle, bordered at the base by an elliptical curve. There are several points of somewhat less importance to which attention might be called, which add to the grace of the lamp. The feeling of the design is colonial. This is strengthened by the application of the oil font and it is, therefore, appropriate to apply a colonial type of urn at the top of the stem and a similar finial below the font. The application of the oval-ball spacer between the arm and the font tends to improve the design.

The last item to be considered is the finish. It is a well-recognized fact in other crafts that a finish can make or break a piece of otherwise attractive work. In fact, a good finish will often cover slight deficiencies in design or workmanship. The choice of an appropriate finish and its careful application are, therefore, of great importance.

The finishes of wrought iron have been and still are subject to much debate in architects', artisans', and decorators' circles, but it is generally conceded that this as well as any other material should be finished in a manner expressive of its own spirit and in its own natural color or slight variations thereof. Under "natural colors" are included those induced by the elements and through long age. These may be simulated by artificial means. Frequently the decorative deviations that have been practiced by the master craftsmen of the renaissance period are also considered good practice.

There are an abundance of finishes which may be applied to iron, not all of which, however, can be used in the average school shop for lack of necessary facilities. The following recommendations are given those types of finishes which may be used in the school. First, then, there is the *natural iron,* the color of the iron with but slight changes from the way it appears when bought; the *half polish* which contrast the actual silvery color of the metal against the dark natural color particularly where the iron has been hammered; the *rusty colors,* either induced by artificial means such as brine or acids, or simulated with suitable paint materials. The latter is preferable as it is safer, and also because a far greater variety of tones and gradations can be obtained. Then, there are the *polychrome effects* which call for the use of colors and gold. Their application requires a good deal of skill and a fine sense of color harmony. It is best to use the polychrome effect sparingly, and to *antique* it, if it is used, in order to tone down the colors. Some blatant abuses in the use of finishes may

(Continued on page 116)

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

J. J. Metz, Editor

Surveys Which The Shop Teacher Can Make

The survey of drafting-room practices which was made by the committee of mechanical drawing of the Michigan Industrial Education Society is a piece of work that bears careful study and scrutiny not only by the teachers of mechanical drawing in our schools, but by the draftsmen in industrial plants as well. While the action of a majority cannot always be taken as the criterion of what is best, nevertheless it is significant that such action must have something to commend it, especially when it has to do with a method of performing a piece of work or an operation in a certain way, or of adopting a specific symbol to represent a given thing or thought. It is in this way that the work of Mr. Kepler and of his co-workers on the committee will have influence in the field of mechanical drawing. The results of their work should be carefully scrutinized by teachers of mechanical drafting because it is best to teach the boy in the school that which he can apply directly when he enters industry later on.

The committee that made this exceedingly worth-while study are to be complimented because of the timeliness of their work. Almost six years had elapsed since a similar study of drawing practice had been made single-handedly by H. D. Campbell of the J. Sterling Morton High School, Cicero, Ill. The work of the Michigan group shows that the teachers who belong to the Michigan Industrial Education Society are firm believers in the theory that instructors in the field of industrial arts and vocational education must keep abreast of changes made in industry. This study made by the Michigan teachers, then, is not to be looked upon as a check of Mr. Campbell's earlier work, but rather as an extension of that study, bringing it up to date, and insuring that the teaching in school prepares the boy for eventual entry into industry as a draftsman, or as a mechanic who is thoroughly familiar with the methods of representation used by the draftsman.

Campbell, Kepler, and their co-workers, have shown that they are progressive teachers of industrial arts and vocational education who take their work of instructing the young very seriously. They are not content to teach what they themselves were taught ten or more years ago at a teachers' training school. They know that many things have changed since then, and they go directly to the source to find out what these changes are.

This method, however, need not be confined to drafting-room teachers. There are many other shop teachers who might well follow the splendid example set them by their brothers in the field of drawing.

Unfortunately, there are too many instances where the school-shop teacher and the mechanic in industry are at variance. Industrial-arts work as well as vocational instruction can be improved greatly when the contact between industry and school is firmly established. Not only will the teaching results be better, but more friendly relations will result from such efforts at co-operative work, with the result that the work in industrial arts and vocational education will be more firmly established as a necessary part of the public-school curriculum.

That industry values and appreciates research work of this kind is shown by the fact that no sooner had Mr. Campbell finished his first survey, when the American Society of Mechanical Engineers asked him to become a member of their committee working toward the standardization of drafting practices for our country. This is real recognition because the American Society of Mechanical Engineering wields an enormous influence in the field of engineering and industry.

The question arises, What can the teachers of woodwork, metalwork, electricity, printing, automotive, and other school-shop subjects do which will be comparable to the survey made by their brothers in drawing?

Are there similar questions which they might want to ask their brothers in industry?

Are they not equally interested in checking their procedures in school with those practiced by the artisan? Would they not gain more surety in their teaching, and would not their courses obtain more prestige in the community if their work were thus unified with industry? Would not their course be vitalized greatly by the knowledge that the practices in school and industry coincided?

It is well to think about these questions. The drafting-room teachers have shown a way. It is for the others to follow and to profit by the experiences gained in the surveys to which reference has been made.

Prevacation Thoughts

It may be a little early to give the spring-fever bug a chance to get in his deadly work, but, nevertheless, it is well to start planning for the work that is to precede the vacation time which is fast approaching, and then to make a program for the summer season itself.

This planning may well include consideration of those things which have to do with the pupil, the school shop, and finally with the teacher himself.

For the pupils' interest, it is well if the teacher studies the present status of the membership of his classes. Are the students progressing properly? Can something be done to improve the method of teaching to help raise the general level of the class? Has a definite testing program been arranged? Does the plan of shop organization give the student an opportunity to develop independence of thought, leadership, self-reliance, ability to co-operate with others? Is the student made to feel that the projects on which he works, the maintenance of the tools and equipment which he uses, the housekeeping problems in the shop, his individual progress as well as that of his fellows, are all things which must concern him vitally? Can something be done, even as late as this, to bring about some of these desired outcomes?

The prevacation plans which concern the school shop must consider quite a number of things. There is, for

instance, the problem of inventory taking. Steps are in order now, which will simplify this troublesome yearly chore. Out of a study of the inventory comes the necessity of requisitioning replacements, materials, and supplies. Involved in it, also, is the bookkeeping which has to do with the collection of money for used materials and supplies. This frequently presents a troublesome problem and it is one that had better not be delayed too long. Then, there is the question of checking up the present layout of the room. Is it adequate? If not, can something be done to make it so for the present class, or at least for the incoming class next fall? Must provisions be made to install new equipment this summer? Can some of the preliminary work be started now as a class project? Have plans been made for an exhibit of student's work to be held shortly before school closes? Have possibilities for an exhibit of the school's shopwork at county or state fairs been investigated? Is some kind of contest for the students planned for the spring months? It takes time to arouse enthusiasm for such an exhibit or contest, and it is well to start early.

As for the teacher's vacation — what plans for this may be made as early as this? Of course, many teachers made up their minds last summer about what they would do this vacation. They did well to plan early. Many, however, have left the decision for later, and for these it is well not to delay their decisions too long. The summer-school advertisements are already appearing. Read them — they may point at a way of spending not only a delightful but an extremely worth-while vacation.

Asking General Questions

Not infrequently, inquiries are received asking "What will be the cost of installing a general shop in our school system?" "Please send us a list of the equipment required for a machine shop." "What will it cost to put industrial arts into my school?" These and many other questions of the same general type might be quoted at length.

It would seem that these questioners would at least stop to consider that the person to whom they address such a question may not be acquainted with the facts surrounding their particular problem, upon which his answer must necessarily be based. They must recognize that the person to whom they are writing cannot possibly get a real picture of conditions from such a one-sentence question, unless the questioner is thoughtful enough to give all of the details which are involved.

The statement "our school system" usually means nothing to a person living hundreds of miles from the village or town from which the inquiry comes. Then, too, what is the underlying principle that prompts the original question? What does the inquirer want to achieve with his industrial-arts course? Judging by the bland question "What will it cost to . . . ?" it is even questionable whether the person sending in the inquiry has any conception of the philosophy underlying the work which he is planning to include in the curriculum.

The problem, then, is not one of making out an equipment or price list in answer to such a question, but of pointing out to the inquirer what his question is based on. He must be led to think his problem through. He must be shown what it encompasses and that it is not a question merely of equipment, room space, costs, and the like, but basically one of deciding why it is necessary to make industrial arts a necessary part of the school experiences of present-day youth, and then analyzing just what is best, under local conditions, to include under the generic name — industrial-arts work. Having decided the course contents, class size, students' ages, available room size, size of project work to be undertaken, eventual use of the school shop — whether it is to be used for day-school purposes only or whether it is to be made available for adult training in evening classes — then and only then can a definite list of required equipment be established. If these things are not taken into account, there is little hope that the problem will be solved satisfactorily.

This Matter of Testing

There are still many teachers of industrial arts and vocational education who do not feel that they need any tests whatever to disclose to them what their students know about a given shop subject. As one teacher put it, "If I have watched a boy in my shop for a whole semester, I know what he can do without giving him any fancy tests."

This statement may be true, if the shop teacher is aiming merely at the transmission of skills, and even then a teacher may go far astray in his conclusions, for teacher appraisals have been proved quite inadequate as measuring devices. Considering, however, that skills are only a part, and at best a minor part, of the outcomes of industrial arts and vocational work, such superficial judging of what the boy has acquired from his shopwork is entirely inadequate.

A plan for testing, then, is as necessary in the school shop as it is in any other subject, and the matter of deciding what kind of test to give must be carefully considered. Unfortunately, too many shop teachers are still unacquainted with and, therefore, more or less afraid of the subject of tests and measurements. It is a subject of vital importance, however, and every ambitious shop teacher should acquire a thorough knowledge how to measure achievements and aptitudes.

Much has been written on this subject in educational periodicals, and there are quite a number of books available for a study of the subject. Besides this, there are a number of these tests published which have been standardized so that the teacher can compare the standings of his students with those obtained in schools the country over.

It is well, however, not only to know how to apply tests. The results of the tests should stand for more than merely a method of assigning a grade. Not only must the results be summarized, but they must be interpreted so that the testing will assist in the constant bettering of the subject and its method of presentation. It is only when the results of testing are used in this way that the full benefits of a testing program are achieved.

ARTISTIC WROUGHT-IRON WORK — VI

(Continued from page 113)

be noted. One of the most inartistic is the application of bright enamel colors upon which bright yellow gold dust has been blown. If colored enamels are to be used, the darker variety is recommended and the color should be amply antiqued to take off its hard gloss. Gold should most assuredly not be used in the aforesaid manner. It may be applied locally at a termination, for instance, or at an outstanding decorative adjunct such as a husk or a tulip. If used in this way, a dark, rich gold should be chosen, and this should be antiqued to take off its brightness and make it flow gradually into the basic colors.

As a protective coat for half-polish finish, varnishes or glossy drying lacquers are frequently resorted to. These create a harsh gloss which detracts from the best piece of work. A dull-drying, clear lacquer or several coats of beeswax do not have these objectionable features. Since clear lacquers are not readily applied with a brush, we suggest their use only where spraying equipment is available.

The Wrot Iron Designers have prepared a treatise on the finishes of iron which is at the disposal of those interested, as is their "Free Advice and Consulting Service."

Casting in the School Shop—V

N. A. McMillan

Elmira, New York

The fifth of a series of lessons on molding. Previous lessons in this series have appeared in the January and September, 1934, and May and October, 1935, issues of this magazine.

CASTING IN METAL MOLDS

There are two types of metal molds used for making castings: *die casting* and *permanent-mold casting*. The difference between the two lies in the method used in getting the metal into the mold and in the way the mold is cooled. Die castings are made in water-cooled metal molds where the metal is forced into the mold by pressure. Permanent-mold castings are made in metal molds that are usually air cooled and the metal is poured into the mold, the only force used being that of gravity. The method of making die castings and permanent-mold castings is so different in detail from sand-casting work, that they are separate industries.

Die Casting. The die casting in metal molds under pressure is limited to aluminum alloys and alloys of lower melting temperatures. Die castings are used for relatively small castings which must be produced in large quantities.

Permanent Molds. Some types of permanent-mold castings are possible even in a school shop. Figure 33 is a good problem in permanent-mold casting. The mold is shown in Figure 34. Cast-iron molds are generally used, and the castings are made in aluminum alloys, cast iron, brass, and bronze. Aluminum pistons, bronze worm gears and many other small castings are cast by this process. Cores may be either of metal or sand.

The molds are not coated for casting aluminum. When casting cast iron, the molds are coated with china clay made sticky with water glass and applied to the molds while hot. A coat of lamp black is applied between each coat.

Vents must be provided to prevent trapping air in the molds. The proper working temperature of the mold must be maintained to about 400 deg. F.

Comparison of Die Casting and Permanent-Mold Casting

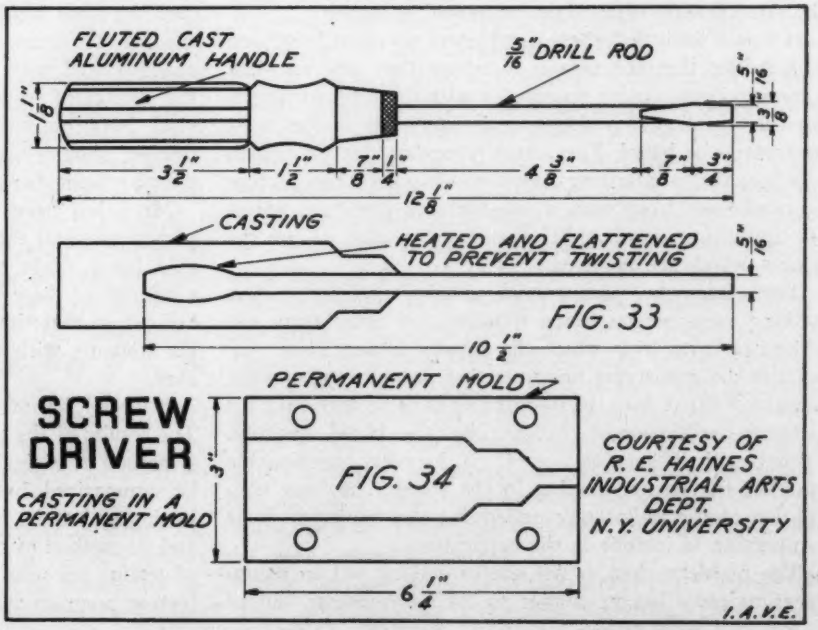
Zinc-base alloys are used in the larger proportion of die casting. Aluminum also is used. Die casting can be economically made only where continued production of large quantities is desired. One set of dies produces from 25,000 to 200,000 castings in aluminum alloys and will last much longer for zinc alloys. The cost of dies is so high that unless thousands of castings are needed, the die-casting method is not economical.

Permanent molds are not as expensive as die-casting machines, and castings may be economically made in much smaller quantities, even as low as a few hundred at a time.

The accuracy of die castings is high and may be held within 0.001 in. This eliminates machining almost completely. Aluminum castings made in permanent molds can be held within the limits of 0.010 in. and so cannot compete with die castings for accuracy, but they fit jigs for machining much better than sand castings. Permanent molds for cast iron are not claimed to be better than sand as far as accuracy is concerned.

The quality of permanent-mold cast-

(Continued on page 122)



The screw driver and the permanent mold for casting the handle

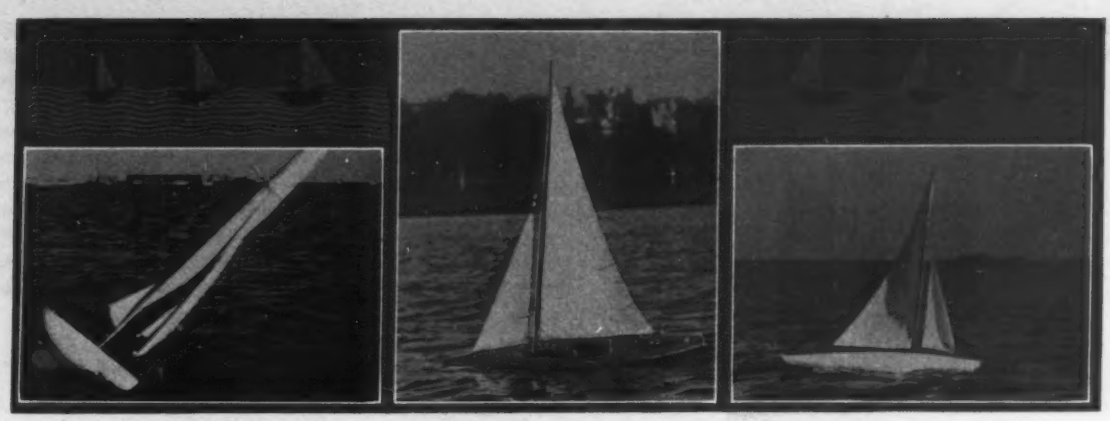


Fig. 1. The 50–800 Marblehead Sloop

A Marblehead-Class Sailing Sloop

Claude Wm. Horst

Milwaukee Vocational School, Milwaukee, Wisconsin

A 50-in. sailing sloop with a sail area of 800 sq. in. The hull of this model is finished in halves, assembled with a backbone structure between them.

The Marblehead-Class sloop shown in Figure 1 is commonly called a "50–800" sloop, because the principal requirements for it are that the hull must have an over-all length of 50 in., and that the sail area must be 800 sq. in. The sloop has been kept simple so that those competing will have little difficulty in making a yacht that will qualify. The rules given here are for 1935, and presumably are subject to change. For that reason it is advisable to get in touch with the Model Yacht Association of America before one builds a boat with which he plans to compete in one of their regattas.

Marblehead Class Rules

I. *Hull Restrictions.* The hull shall be 50 in. over-all length, with a permissible variation of ¼ in. under or over this dimension. There is no limit to the waterline length, or to the displacement. Movable keels, fin keels, centerboards, bilge boards, leeboards, bowsprits, and overhanging rudders are prohibited. Bumpers are not included in over-all length, but are limited to ⅛-in. overhang.

II. *Sail Area.* The sail area is not to exceed a total of 800 sq. in. There are no specific restrictions on the area of any individual sail, so long as the total area does not exceed the stipulated allowance.

III. *Regulations for Measuring.* All points of measurements shall be definitely marked by a black band 1/16 in. wide on spar or stay beyond which the sail must not extend, such band to be put on by the official measurer.

IV. *Formula for Computing Area of Sail.*

Headsail or jib: The product of the length of the luff multiplied by the shortest distance between the luff and the clew, divided by two.

Mainsail: When this sail is of triangular shape, the area is found by multiplying the length of the luff by the shortest distance between the measuring mark at the end of the boom and the mast, and dividing the product by two. Headboards are not included in the sail area.

V. *Battens.* Four battens not more than 4 in. long in the mainsail, and three battens not more than 2 in. long in the jib are allowed. All battens must be equally spaced.

VI. *Headboards* are allowed, but must not exceed ¾ in. across the base.

VII. *Spars.* Any increase in the sail area obtained by the use of bent spars will be measured as a bow and included in the sail area. Hollow spars are allowed. Models must always sail with spars as measured. The greatest diameter of the spars is limited to ¾ in. Spars are not included in the sail measurement. There is no restriction as to scantlings nor as to material.

VIII. *Spinnakers.* The outer end of the spinnaker boom must not extend beyond 12 in. from the center of the mast. The height of the spinnaker is measured to the upper point of the forward triangle.

Construction Procedure

The hull is made of two completely finished halves which are constructed of ¾-in. lifts, or layers. Not until these two hull halves are completely finished both inside and out are they assembled with the backbone structure in between. This type of construction has a number of advantages over the lift method as commonly used. The left and right piece for each lift can be compared and made identical, and the insertion of a real backbone structure (stem, keel, and horn timber) which becomes an integral part of the construction makes a very sturdy fin and skag construction.

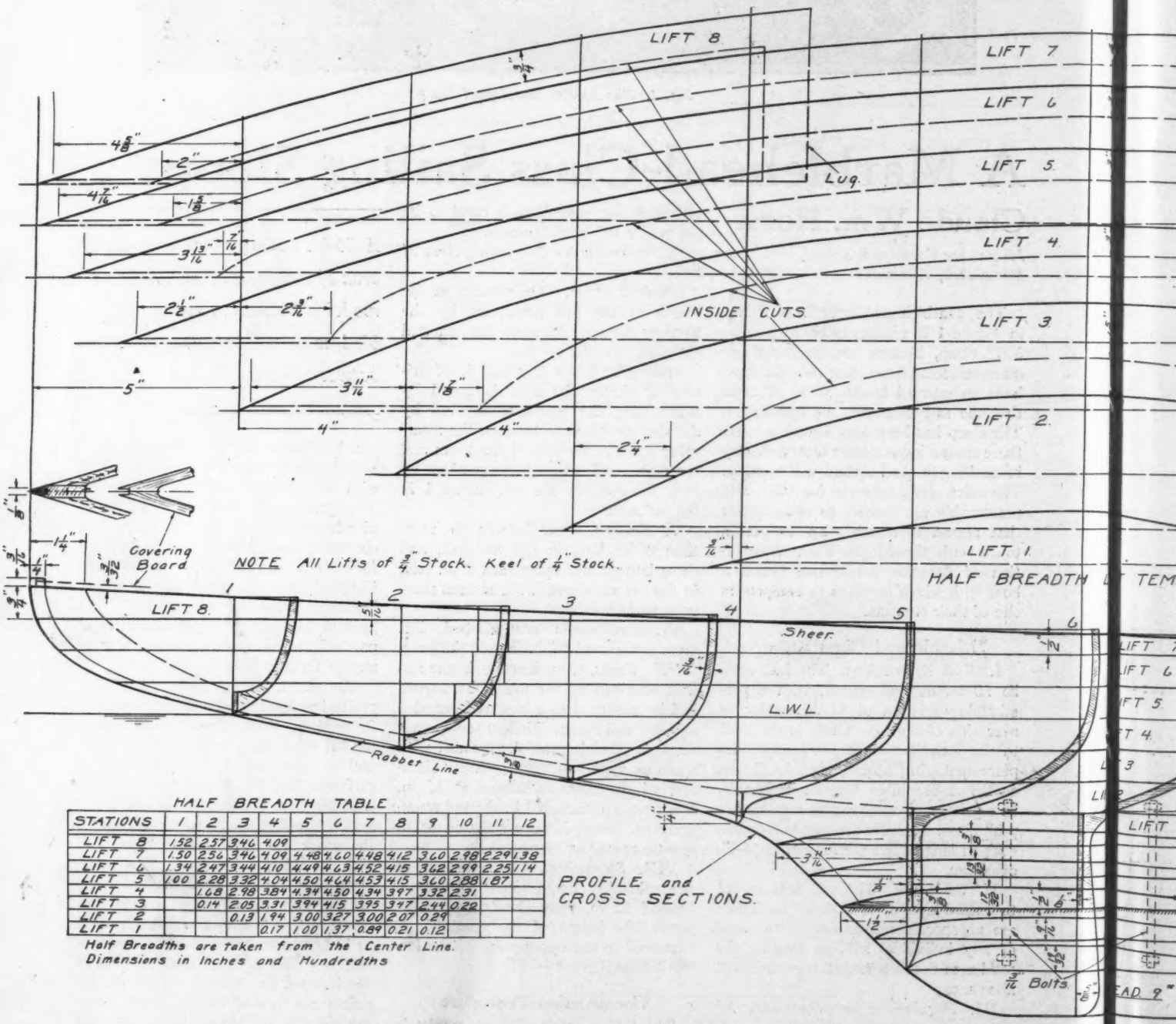
The Lifts. Select some good fine-grained well-seasoned material and dress it to ¾ in. thick. One of the edges of the lift stock must be perfectly straight and at right angles with the two flat surfaces. The length and the width of each lift piece is shown on the line drawings, Plate I. Use the surfaced edge of the stock for the working edge, and with the aid of a try-square draw transverse lines on the lift stock according to the dimensions given in Plate I. Number all the transverse lines from 1 to 12 according to the stations they represent. ("Stations" are cross sections of the hull.) The distances which the lift points are located out from the center are given in the half-breadth table; for example, the first station having a dimension for lift 1 is station 4 where

lift 1 is .17 in. from the center line. At station 5 it is 1 in., at station 6 it is 1.37 in., and so on. After all the points have been located, draw a curve through them with the aid of a ⅛-in. square flexible batten, somewhat longer than the hull.

Cutting the Lifts. After all the lift curves have been drawn, draw a line parallel to the working edge and ⅛ in. from it. This ⅛ in. of stock represents the thickness of half of the keel and must be removed. The keel will be added later when the hull halves are assembled.

Cutting the lifts must be done accurately as each curve has been carefully designed and must not be altered. Saw on the outside of the line and finish to it with a plane or a disk sander. Although the hull shell will finally be very thin, it is advisable to do as is shown in Plate I and cut the lift pieces ¾ in. wide. Otherwise the lift pieces would be so flexible that an accurate glue job could not be obtained.

Assembling the Lifts. After the lift pieces have all been finished, mark the position of station 6 on the outside edge of each one. Check all the pieces with their mates to see that they are identical. Arrange the pieces for one hull half on edge in their proper order on



HALF BREADTH TABLE

STATIONS	1	2	3	4	5	6	7	8	9	10	11	12
LIFT 8	1.52	2.57	3.46	4.09								
LIFT 7	1.50	2.56	3.46	4.09	4.48	4.60	4.48	4.12	3.60	2.98	2.29	1.38
LIFT 6	1.34	2.47	3.44	4.10	4.49	4.63	4.52	4.15	3.62	2.99	2.25	1.14
LIFT 5	1.00	2.28	3.32	4.04	4.50	4.64	4.53	4.15	3.60	2.88	1.87	
LIFT 4		1.68	2.98	3.84	4.34	4.50	4.34	3.97	3.32	2.31		
LIFT 3		0.14	2.05	3.31	3.94	4.15	3.95	3.47	2.44	0.22		
LIFT 2			0.13	1.94	3.00	3.27	3.00	2.07	0.29			
LIFT 1				0.17	1.00	1.37	0.89	0.21	0.12			

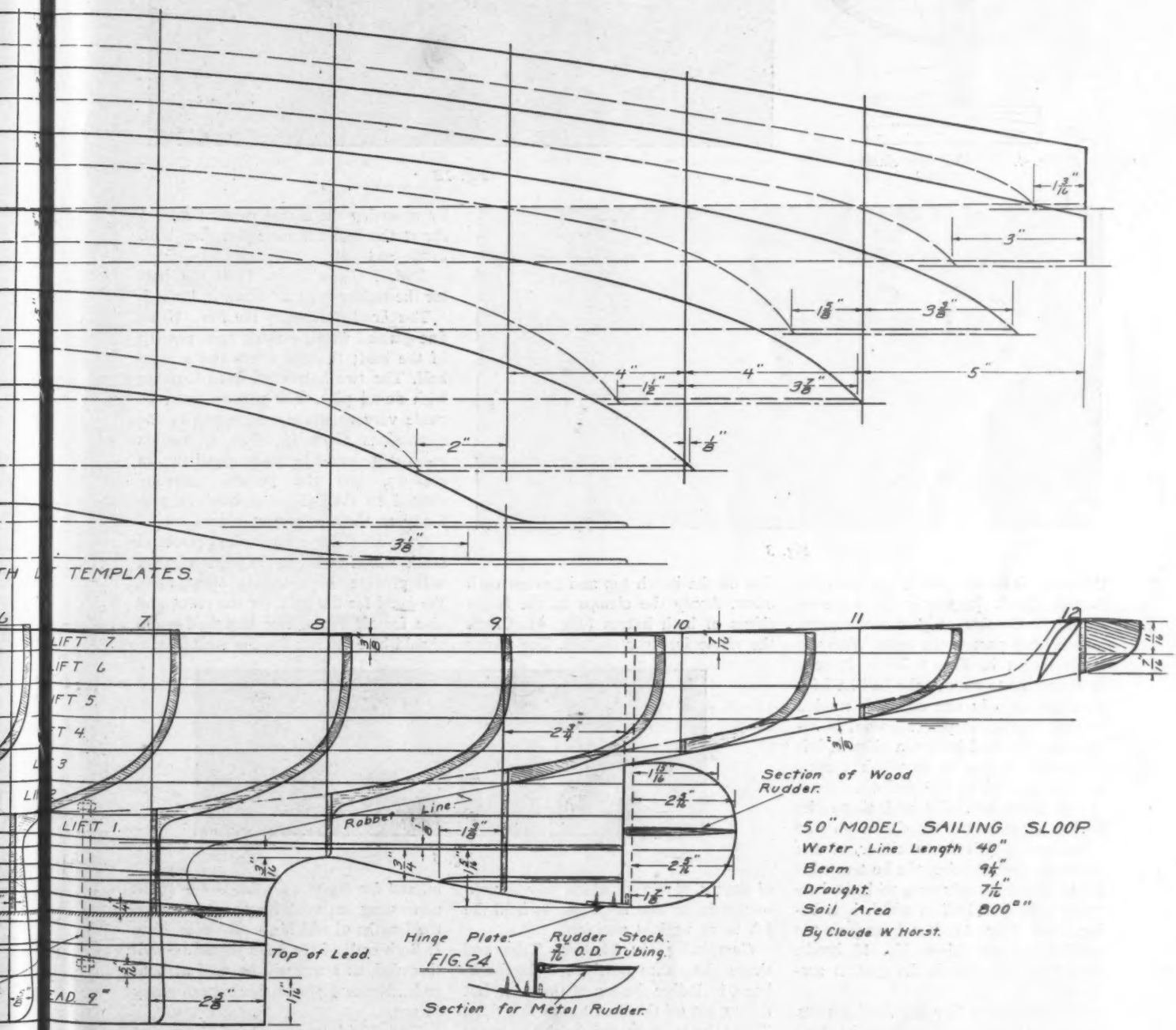
Half Breadths are taken from the Center Line.
Dimensions in Inches and Hundredths

Plate I. The 50- *Marblehe*

the bench top, lining up all the station 6 marks. Note the function of the lug on lift 8. Figure 2A shows the lifts for one hull half properly arranged. Then, before glue is applied, arrange the lift pieces for the other half in the opposite order to be sure that the two halves will not be made for the same side of the boat. Mark the overlapping of the lifts and apply glue to both contact surfaces of each lift. It is usually wise to glue together only a few lifts at one time. During the gluing process be sure that the lifts are in contact with the bench top. Small pins or brads may be a great help to prevent any shifting during the gluing.

Shaping the Hull Halves. To aid in shaping the outside, make a number of cross-section templates of cardboard according to the cross sections of Plate I. Mark off the hull for the application of these templates and shape the hull so these will fit accurately at their respective positions. Screw a piece of scrap material across the keel surface by which the job may be held in a vise.

To shape the inside, the hull halves must be held securely with the aid of wedges, props, and clamps (Fig. 2B). These must be placed so there will be no unnecessary strain placed on the hull shell as this will be quite thin after all



The 50" Marblehead Sloop

Fig. 2A

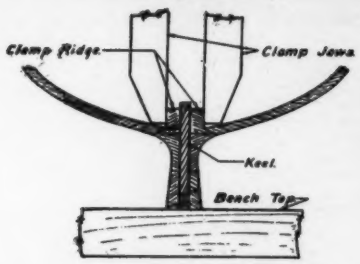


Fig. 4. Showing how clamps are applied

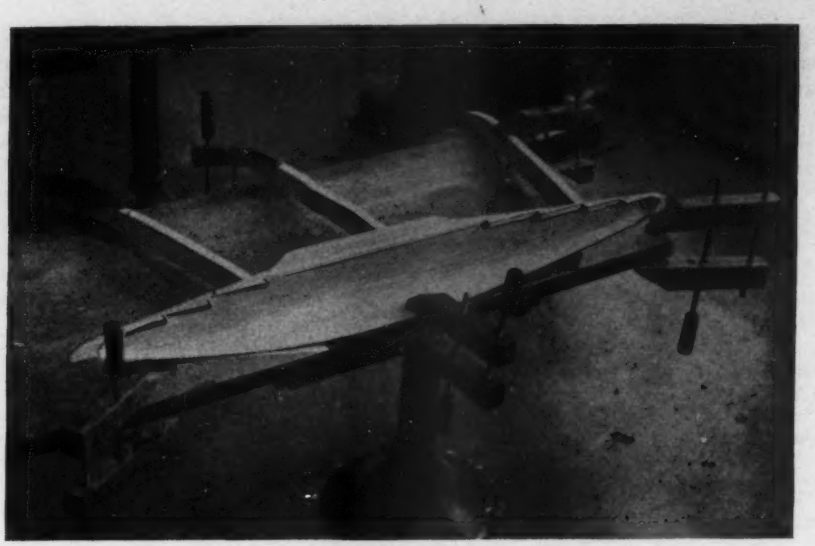


Fig. 2B

Fig. 3

the stock from the inside has been removed. Check frequently for an even thickness. Outside calipers are a great help for this part of the work. With the setup shown in Figure 2B it is very little trouble to remove the hull half for checking as only one clamp is needed to hold the job in place. To aid in assembling the hull halves, a ridge is left along the keel edge to which clamps may be applied (Fig. 3 and 4).

The Backbone. Cut and shape the backbone structure as shown in the drawings. Attach it to either of the halves, being sure that the bottom edge of the keel is exactly even with the bottom of the hull half to which it is being fitted (Fig. 4). For fastenings use casein glue and ¾-in. No. 18 brads. Apply the glue to all the contact surfaces.

Fastening Together the Hull Halves. Stand both halves in an upright position on the bench top and against each other. Apply the clamps to the inside ridges of both halves (Fig. 4). Check the whole for poor contact. Use plenty of clamps, several of which may be used on the fin, as that helps also to hold the job in an upright position.

Completing the Shaping. Trim and shape the entire outside of the backbone, including the top of the stem, but do not cut off the stem top at this time. Shape the transom and finish the inside by removing the clamp ridge. Figure 5 shows the hull completely shaped both inside and out.

Rudder Tube Hole. Drill the hole for the rudder tube as shown in Plate I.

The Lead Portion of the Fin. Using fine-grained wood, make a split pattern of the lead; that is, a left and a right half. The two halves are held together with dowel pins. The pattern must be made very accurately according to the dimensions given in Plate I. Section templates should be made of all the fin stations, and the pattern carefully shaped so that the templates fit perfectly at their respective places.

Secure, or shape, half-round pieces of stock, which added to the pattern halves will provide the necessary openings in the mold for the gate, for the bolts, and also for air vents. The bolt half-round should be 3/16-in.; for the vents, 3/16-in. and for the gate, ⅜-in. Use 3/16-in. nonrusting material for the lead bolts, the lengths of which are shown in Plate I. Both ends of the bolts should be well threaded, as a nut will be used at both ends. Figure 6 shows the pattern ready to use.

Fig. 5

The Mold for the Lead. The best

and safest way to get a good lead casting is to take the pattern and enough lead for the job to a foundry, and for a few cents, take home the casting.

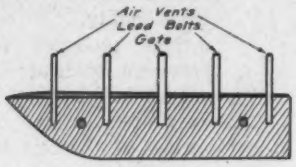


Fig. 6

However, for the one who wishes to be his own foundryman these directions are given.

Make two frames (the foundryman would call them flasks) exactly the same size and large enough to hold the entire pattern. A box of the proper size may be cut as shown in Figures 7 and

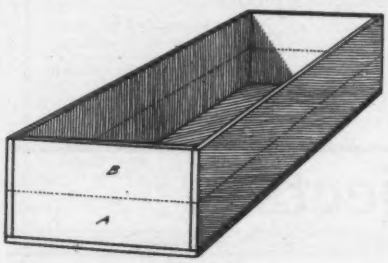


Fig. 7

8. The parts may be labeled A and B for reference. Drive a few nails through the sides of both A and B as shown in

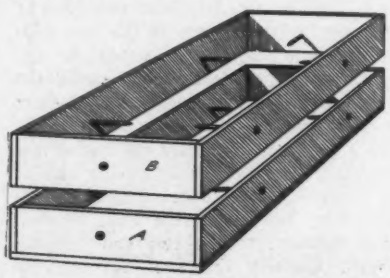


Fig. 8

Figure 8. This is to hold the plaster in the frames. Nail lugs to frame B as

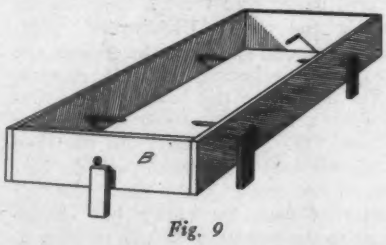


Fig. 9

shown in Figure 9. These lugs assure that the frames are placed together accurately.

Mix enough plaster of paris to fill only one of the frames at a time, as it sets very rapidly. Put the paste in frame A and push one half of the pattern into it so that the pattern is exactly even with the top edge of the frame. Check with a straightedge to see that this is

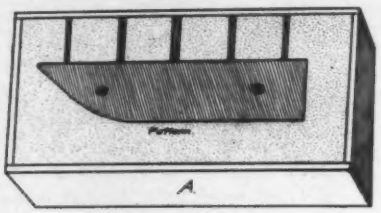


Fig. 10

so. Figure 11 shows a cross section of Figure 10. In adjusting the second half of the pattern in frame B care must be taken to see that it is in the same relative position as was the first half of the pattern in frame A. First place a piece

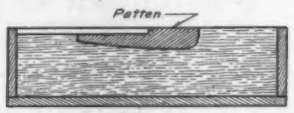


Fig. 11

of waxed paper over the top of frame A after the plaster is set. Punch holes through the paper for the dowel pins and place the second half of the pattern in position on top of the first. Place frame B in position over frame A (see

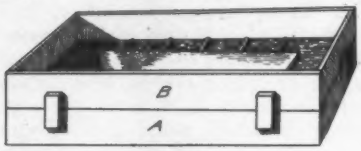


Fig. 12

Fig. 12), and fill it with plaster of paris. When the plaster has thoroughly hardened, lift off frame B, and the mold should part easily at the waxed paper. Remove the pattern from both frames and patch up any broken places.

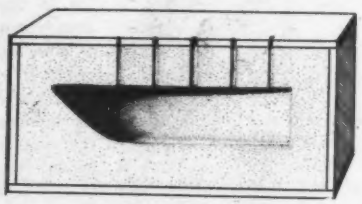


Fig. 13

Cut holes in the frames for the gate, the bolts, and the air vents. The holes for the bolts must be cut accurately, but one need not be so particular about the others. Before using the mold, be sure that it is thoroughly dry. Figure 13 shows half of the mold ready for use.

Casting the Lead. Before pouring the lead, place the bolts in position on frame A with a nut screwed to the lead end. The bolts should be held so that the nut will be about the center of the lead. Then place frame B in position on frame A (Fig. 14). Hold the two frames together with clamps at each end, or

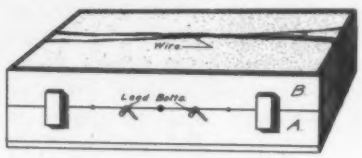


Fig. 14

wrap wire around them. Set them on edge as shown in Figure 15 and pour the lead. It is well to melt nearly 10 lbs. of lead as there is more or less waste.

Fitting the Lead. When the lead is removed from the mold, or brought back from the foundry, it must be

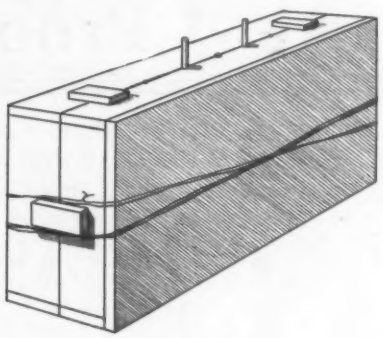


Fig. 15

smoothed and weighed. If it weighs less than the required 9 lbs. it must be recast, first, of course, rechecking the pattern for accuracy with the drawing. A small amount of excess weight may be removed very easily, and is allowed for in the drawing to permit trimming, fitting, and some lateral balancing. Mark very carefully on the fin the location of the holes for the lead bolts. Bore from the outside of the fin in toward the center of the hull. Since the fin is narrow, great care must be taken that the boring is done accurately. Also the lead must line up perfectly with the fin. Sometimes it is necessary to use a rat-tail file and enlarge one side of the hole to accomplish this. When this is done, tighten the nuts and then fair-in the lead with the wood part of the fin.

(To be continued)

CASTING IN THE SCHOOL SHOP—V

(Continued from page 116)

ings is better than that of die castings. There is some defect in the action of the metal in the die-casting process. The molten metal is rapidly forced into a mold and cools very rapidly. As a result, shrinkage cavities are scattered through the metal. The surface of the casting is smooth and its strength high, but internal shrinkage is a characteristic defect of the castings made. Permanent-mold castings can be fed from gates and risers which help to prevent internal shrinkage and cavities in the same manner as in sand castings. In both aluminum and gray-iron permanent-mold castings, increased strength and better wearing properties are obtained, due to the fine grain produced by the rapid cooling of the castings as compared to that of the sand-cast castings.

QUESTION SHEET

Directions: This is a true-false test. Make a circle around the capital T if you think the statement is true, or make a circle around the capital F if you think the statement is false.

T F 1. A permanent mold is mostly made of metal of a high melting point.

T F 2. A die-cast mold is made of soft metal of a low melting point.

T F 3. The metal is forced into a permanent mold under pressure.

T F 4. The metal flows into a die-cast mold in a natural manner or force of gravity.

5. Comparing these molds as to quantity, quality, and accuracy:

Quantity

T F *a*) Permanent molds will last longer and produce more molds than die-cast molds.

T F *b*) Die-cast molds will produce casting at a greater speed than can be done with permanent molds.

Quality

T F *a*) Castings produced from a die-cast mold are of a higher quality.

T F *b*) Castings produced from permanent molds are filled with air holes.

Accuracy

T F *a*) Castings can be cast within 0.001 in. from a permanent mold.

T F *b*) Aluminum castings made in die-cast molds can be held within the limits of 0.01 in. only.

T F 6. The proper working temperature of the mold must be maintained at about 400 deg. F.

Instructor's remarks:.....
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Problems and Projects

AN ELECTRIC STOVE

E. A. Rerucha, Wakefield, Michigan

The electric stove, described herewith, is constructed from a small aluminum mixing bowl and a tin cake pan, and standard electrical materials. It will perform as well as a good commercial article and so simple to construct that it may be attempted by boys who have not had a great deal of shop experience. The necessary parts and materials are listed on the illustration shown. The construction procedure is as follows:

Locate the centers on the bottoms of the mixing bowl and the cake pan and drill or punch a ¼-in. hole in each. The bolt holding the porcelain brick with the element in place will pass through these holes. Drill four ⅛-in. holes spaced equally and about ¼ in. from the edges in the bottom of the bowl and cake pan so that they coincide and fasten the two together, bottom to bottom, with ⅜-in. iron machine screws, using iron washers under the heads of screws and nuts.

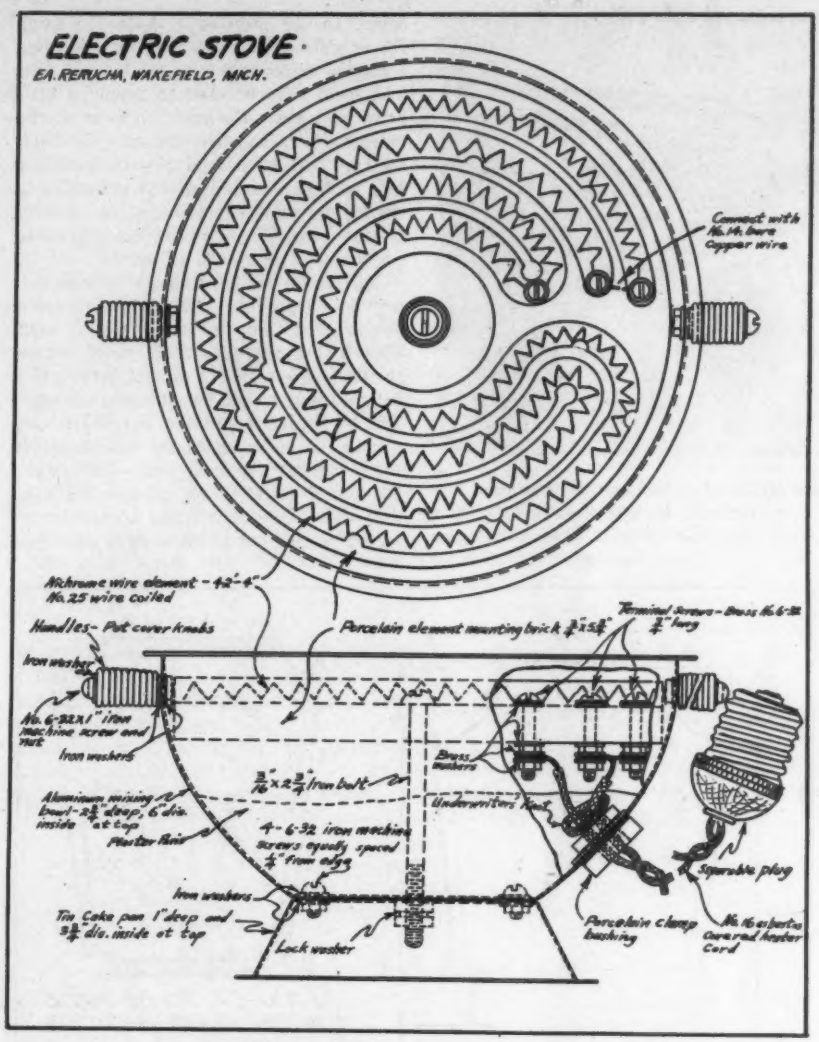
Two pan-cover knobs are used for the handles. Drill a ⅛-in. hole for each handle diametrically opposite and about ⅜ in. from the top of the bowl. Using washers as shown in the drawing, fasten the handles in place with No. 6–32 by 1 in. iron machine screws. Tighten screws securely and cut off and file the ends of the screws if they project too far through the nuts.

Drill or punch a hole for the porcelain bushing in the bowl about in the position shown in the drawing, directly under one handle or halfway between the handles. Install the bushing by inserting the nipple from the outside of the bowl and clamping it on the inside.

The heating element consists of two lengths of No. 25 B & S nichrome wire coiled and connected in parallel and mounted on the porcelain brick. Each length contains 21 ft. 6 in. of the wire. However, it will be easier to work with one continuous piece of wire and doubling it when it is coiled. Therefore use a single piece 43 ft. long. Measure off and cut the wire and wind it tightly, turn to turn, on a piece of No. 6 iron wire. This may be easily accomplished if a winding crank is improvised. Drill a ¼-in. hole through a piece of board about 6 in. long and clamp the board in a vise so that the hole is horizontal. Bend the No. 6 wire in the shape of a crank (a piece of wire about 24 in. long will be sufficient), allowing enough wire on one end so that when it is pushed through the hole in the block there will be about a foot available for winding the element wire on it. Flatten the wire at the winding end and push it through the block. Wind one end of the nichrome wire over the flattened end of the crank wire tightly, lapping it over itself several times to keep from slipping. Then while the wire is being guided with one hand, turn the crank with the other, and the element may be coiled. When all the element wire is coiled, remove it from the iron wire and pull on the ends slightly to separate the turns so that when they spring back in place there will be enough separation to prevent shortening of turns. Double the element in the middle and bend two turns at right angles to the rest for fastening to the terminal screw. Also bend two turns at right angles at each one of the free ends for the same purpose. To mount the element, fasten the doubled end under the joint terminal screw using brass washers on both sides of the nichrome wire to insure a good contact. Place the rest of the element in the grooves under the lugs of the porcelain brick, distributing the turns uniformly, and fasten the ends between brass washers, to the two end terminal screws. Connect the two end terminal screws together with a piece of No. 14 bare copper wire on the bottom side of the porcelain, as shown in the drawing.

Push the end of the No. 16 asbestos-covered heater cord through the porcelain bushing and tie an Underwriter's knot, allowing enough slack cord for making the connections to the terminals of the element.

The bottom of the bowl, and the Underwriter's knot, is covered with plaster of paris. This is to protect the cord and to prevent heat radiation through the bottom of the stove. Mix a thick paste of plaster of paris by adding just enough water to the powder to be able to work it. Fill the bottom of the bowl to the level shown in the drawing. Allow to dry thoroughly. When dry, drill a ¼-in. hole through the plaster of paris from the bottom for the 3/16-in. bolt. Connect the ends


ELECTRIC STOVE
EA. REROCHA, WAKEFIELD, MICH.
Connect with No. 14 bare Copper wire
Nichrome wire element - 42"-4" No. 25 wire coiled
Handles - Put cover knobs
Porcelain element mounting brick 3"x5"
Terminal Screws - Brass No. 6-32 1/2" long
Iron washer
No. 6-32x1" iron machine screw and nut
Iron washers
Brass washers
3/16"x2 3/4" iron bolt
Aluminum mixing bowl - 2 3/4" deep, 6" dia. inside at top
Plaster Paris
Undercut for 1/2"
4-6-32 iron machine screws equally spaced 1/4" from edge
Separable plug
Iron washers
Tin Cake pan 1" deep and 3 1/4" dia. inside at top
Lock washer
Porcelain clamp bushing
No. 16 asbestos covered heater Cord

of the cord to the terminals of the element as shown. Place the brick inside the bowl centering it over the hole in the bottom and plaster, so that it rests evenly on the inside surface of the bowl. Fasten in place with the 3/16-in. iron bolt as shown in the drawing. Attach a separable plug to the other end of the cord and the stove is completed.

If the outside surface of the bowl has been scratched up during construction, it may be polished by rubbing with chalk dust and a piece of felt.

METAL WALL PLAQUE

Paul Marschner, Cincinnati, Ohio

The wall plaque described herewith is a problem in metalwork that has proved very interesting to all the boys in my classes.

Materials Needed

Copper, 20 gauge
Brass, 20 gauge
Aluminum, 20 gauge
Brass escutcheon pins
Plywood board for back
Black enamel
Clear lacquer

Procedure

1. Saw around outline of face with a jewelers' saw.
2. Mark lines on face with a scratch awl.
3. Polish the face, apply clear lacquer.
4. Saw out braid, scratch in all lines.
5. Polish braid with silver polish, apply lacquer.
6. Make band of brass.

7. Scratch all lines in band, polish, and apply lacquer.
8. Drill holes in band for the escutcheon pins.
9. Saw out feathers, scratch in all lines.
10. Polish with silver polish, the feathers may be given a hammered finish, by using a ball-peen hammer.
11. Make plywood board for back, sand, apply two coats of black enamel.
12. Mount metal on board, fasten with the brass escutcheon pins, insert as many as it is necessary to hold metal to board.

REBUILDING HAMMER EDGES WITH OXYACETYLENE TORCH

E. D. Soderstrom, Oklahoma A. & M. College, Stillwater, Oklahoma

The question of buying new hammers or reworking old ones constantly crops up in the forging and welding shop. In the course of time, a satisfactory procedure has been developed by which the edges of the worn hammers are built up with the torch; then they are reforged, hardened, and tempered. In the illustration are shown, on the left, four hammers to be refinished, in the middle, one that has been refinished, and on the right, three that have been in use from one to two years after refinishing.

One of the interesting features of this project is that it contains most of the features essential to proper working of tool steel. A description of the general procedure follows:

Grind out to the bottom any cracks and spalled-off places so as to remove rust, bits of metal, and dirt. Place the hammer in a slow fire and gradually preheat to a low red. Have a helper hold the hammer face up on the welding table and rotate it as welding proceeds. Use a tool-steel filler rod and a little borax flux. Weld "backward," that is, start fusion on hammer edge, then bring the rod down and swing the welding tip back so as to melt a little metal off the rod. The tip should be given an oscillating motion back and forth, diagonally across the edge. This spreads the heat enough to insure fusion between hammer metal and filler. In "backward" welding, the rod follows the flame.

The reasons for welding backward are: (1) the exhaust gases cover the molten puddle until the metal sets, avoiding the oxidizing and nitriding effects of the atmosphere; (2) the filler metal fuses directly into the hammer metal without agitation or overheating, thus meeting the conditions necessary to produce homogeneous structure in steel welds. When the weld is finished, place the hammer back in the preheating furnace, heat to a uniform "red" and anneal it.

The hammer is then ready to

The four hammer heads shown in the lower left-hand corner are to be rebuilt. The single hammer head shows one that has been rebuilt. The three handled hammers have been in use from one to two years after having been rebuilt

be reforged. This is done in the usual manner by heating to nearly an orange heat. Then with a heavy hammer, forge the edges on the first heat, reheat, and on the second heat, forge the face flat. For convenience in handling the hammer during forging, use eye tongs, such as are shown in the illustration. Then anneal the hammer, after which it is to be ground to shape.

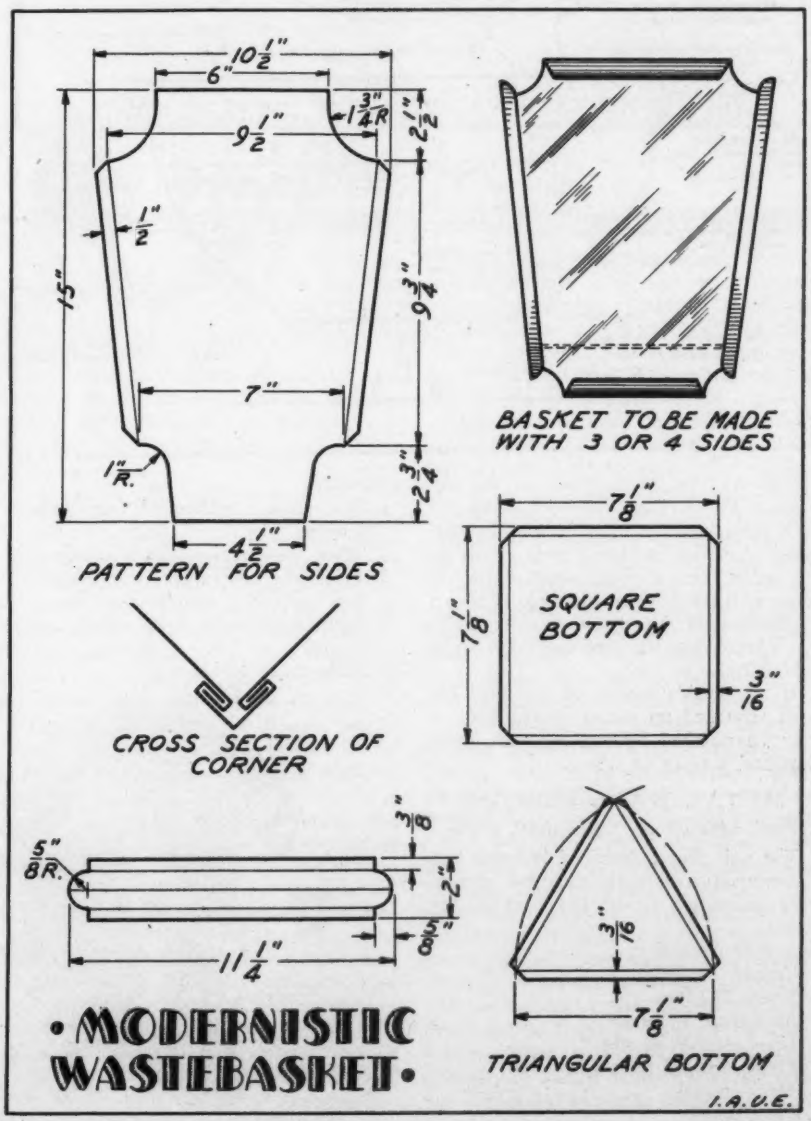
The hammer is then ready for hardening and tempering. For this operation a fountain spray will be found useful. Our fountain consists of a vertical ¼-in. pipe connected to the city-water supply, with a globe valve to control the flow. The fountain is, of course, set up over a tub, close to the furnace for convenience.

Place the hammer inside of a piece of gas-pipe bedded in a slow-burning forge fire, and heat it to a dark red. About ½ hour must be allowed for this step. This is necessary because tool steel conducts heat rather slowly, and any attempt to heat it rapidly by placing it in a hot fire results in cracks more or less parallel to the edges. These are formed because the edges, being more exposed, heat up and expand before the inside does, thus pulling away from the core. In some hardening departments, it is a rule to allow an hour for each inch of thickness in heating steel for any operation.

After preheating, place the hammer in a gas-fired furnace and bring it up to the hardening heat. The gas furnace is better than a forge fire for this operation because the heat can be more easily maintained at the proper temperature in the former.

To harden, hold the hammer so the face is centered over the fountain spray, and let the water play against it until the edges remain wet. Now polish the face with an emery stick, and after placing a small wet dab of asbestos in the center, let the heat run back to draw the temper until a brownish-purple color shows around the edges. In the meanwhile, keep the small center dab of asbestos wet by squeezing a drop of water onto it with a bit of waste. The torch may be used to supply a little extra heat along the edges to even up the temper draw. The ball end may be hardened by heating the end of it to hardening heat with the torch and then quenching in slightly warm water; it needs no drawing. In the case of cross-peen hammers, the edges should be drawn to purple.

The reason for hardening a hammer this way is to produce a hard center and a somewhat softer and more elastic edge. This best meets the condition of impact to which a hammer is subject in use. If a hammer is hardened by plunging, the edges will be hardened and the center left soft due to the insulating steam cushion which forms against the face while the exposed edges cool quickly, thus producing a hammer that will "upset" and spread in the center causing the edges to crack and spall.



MODERNISTIC WASTEBASKET

A. M. Helgerson, Roosevelt Junior High School, Charleston, West Virginia

This project is suitable for eighth-grade sheet-metal students, and is especially popular because it offers several designs that involve the same operations. The laying out of the various parts offers a good lesson in drawing.

Mahogany is a desirable finish for it, and can be produced by mixing a small quantity of red lacquer in black. It also can be made very attractive by blending several colors of lacquer by use of an ordinary "fly-tox" spray that is blown by the mouth. This develops the student's art ability in blending colors.

The beads are made on the gutter beader, but if this machine is not at hand, they can be made by bending around a ½-in. rod. The bottom is fastened by spot soldering.

The wastebasket may be made either square or triangular.

A MEMO PAD

Wayne S. Scott, Manhattan, Kansas

This memo pad can be made in the elementary-woodwork, sheet-metal, or general shop. It gives practice in planing to dimensions and in cutting and bending thin sheet metal. When finished, it makes an attractive gift for mother or father.

The small 3 by 5-in. pads of paper sold in five-and-ten-cent stores are used for paper.

The base may be made from almost any piece of scrap wood. White pine or basswood is probably the easiest for the beginning student to work with. If a really good project is desired, mahogany or walnut may be used.

After the block has been planed to size and chamfered, the machine screws are put in place. Be sure that there is at least 3 in. between the inner edges of the screws, so that the paper will fit between them. To hold the screws in place, a hexagonal nut is countersunk below the surface of the wood. The space around and above the nut should be filled with plastic wood or putty.

The calendar mount may be made of any sheet metal. Sheet copper, galvanized iron, or material from a tin can is excellent. A small hem is bent along the sides of the mount, and the base is made double for added strength.

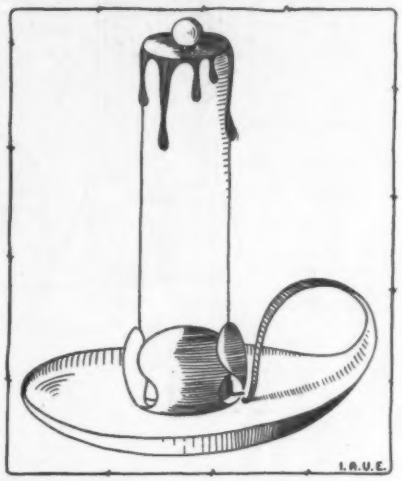
The project may either be lacquered or enameled, or the block can be stained and the whole given a coat of clear lacquer.

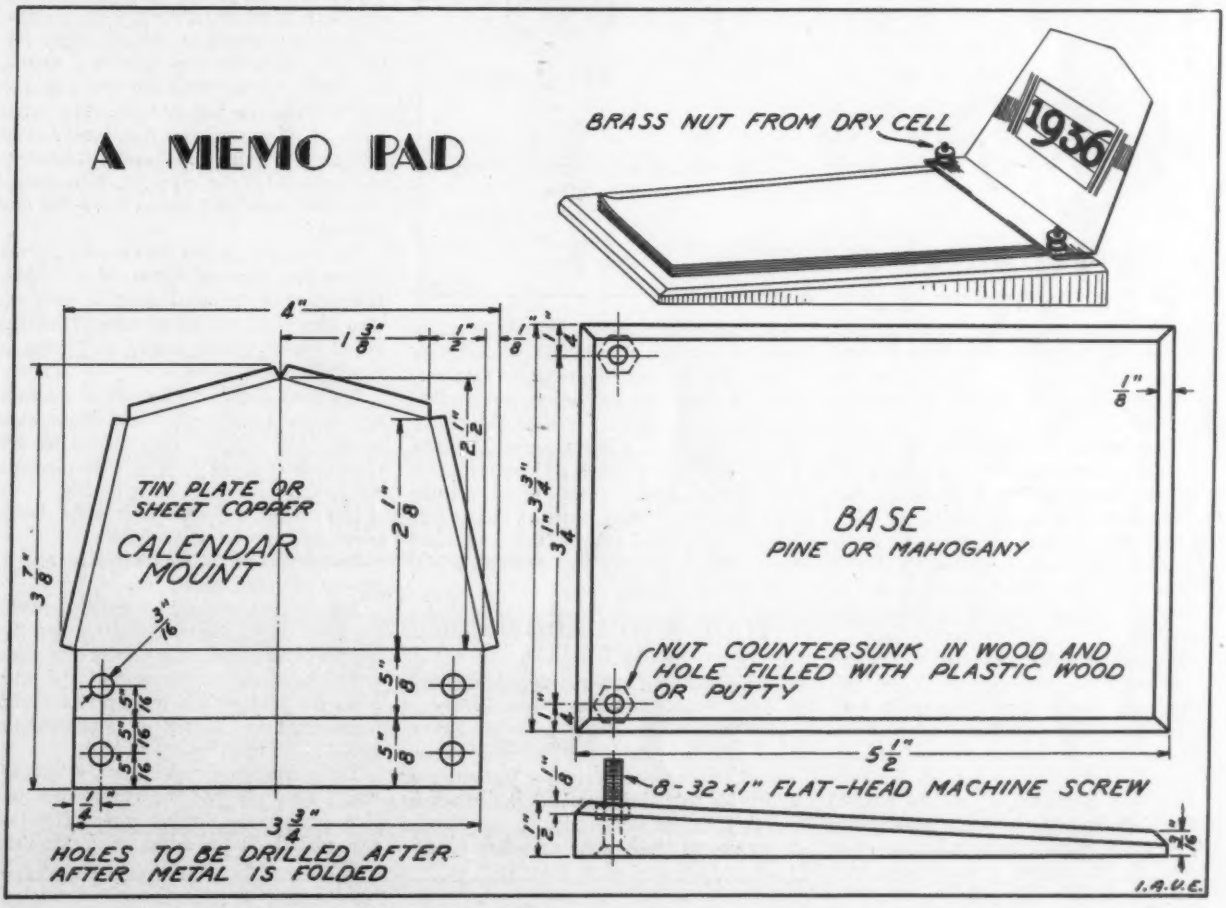
ELECTRIC CANDLE

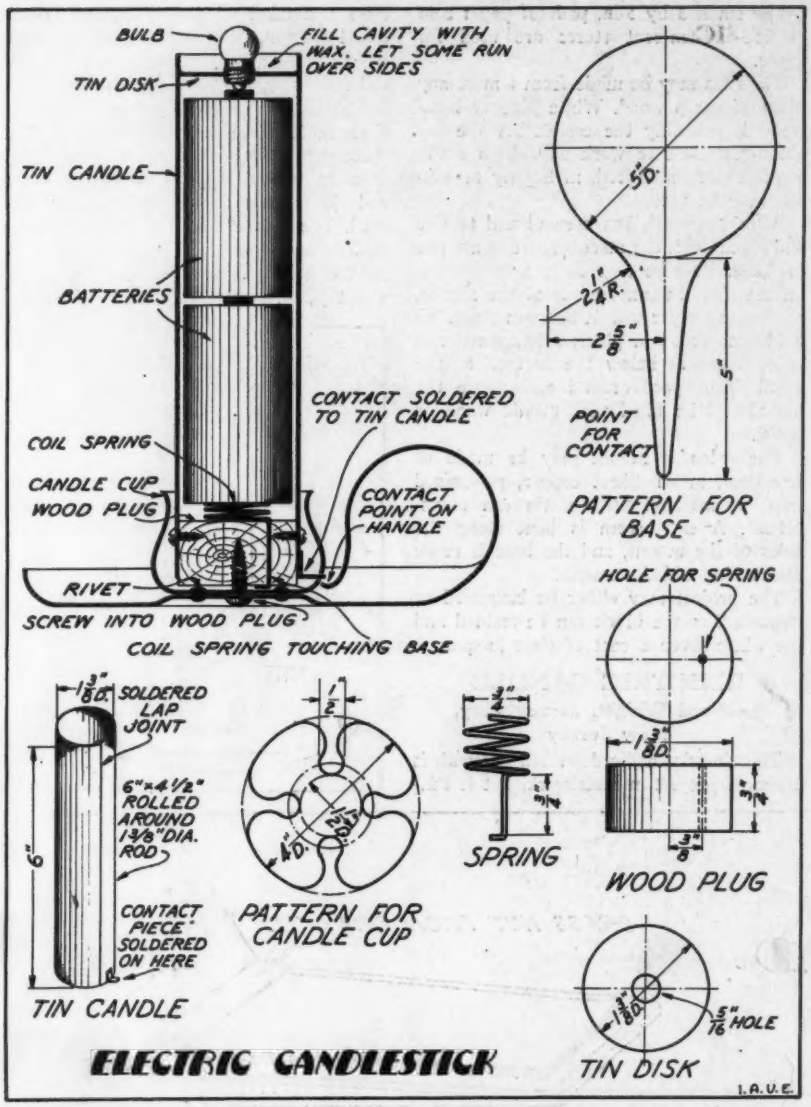
Leonard Wright, Jersey City, New Jersey

The electric candle described herewith is a simple project in metalwork, but it contains a number of interesting and educational problems. Its cost is about 25 cents: 10 cents for a bulb, 5 cents each for two cells, and about 5 cents worth metal.

The candle may be cut from a piece of sheet metal obtained from a tin can. This piece should measure 6 by 4½ in. It must be rolled around a piece of pipe or dowel rod 1⅜ in. in diameter, and then lap-soldered. The disk of tin, 1⅜ in. in diameter with a hole about 5/16 in. in diameter for the bulb, is then soldered into the candle about ¼ in. from the top. A wooden plug







about ¾ in. in thickness is fastened into the other end of the candle. Drill a small hole through this plug for the end of the spring which must go through in order to make contact with the metal base. The wooden plug itself is fastened in the candle with a small screw on each side, leaving the plug projecting about ⅛ in. A small contact piece made of a piece of ¼ by ½-in. tin bent out to form an angle must be soldered to the candle as shown. This piece must be so adjusted that it will touch the base when the candle is lifted, thus completing the circuit and lighting the bulb.

The candle should be covered with white or colored paper, pasting the lap evenly. Melted wax should then be poured around the bulb, allowing some drops to run down the outside to produce a realistic appearance.

The base is hammered out of No. 26 gauge black iron to the shape shown. The edge may be turned upon a wooden plug with a ball-peen hammer. The candle cup is next cut out and the leaves are curled as shown. The cup and the base are then riveted together with two small rivets after which a hole is drilled through the center of both for a No. 8 wood screw. The iron is then polished all over with emery cloth and wax, after which it is heated to color the metal. A coat of lacquer or shellac will keep the base from rusting. The candle and base are then fastened together with a No. 8, ¾-in. r.h. screw.

TOOL AND HARDWARE CABINET

C. M. Jochem, Supervisor of Manual Arts, Pompton Lakes, New Jersey

The cabinet described herewith has a most pleasing and practical appearance. Too often shop accessories are planned and built with only their practical use in mind, but their design should also be considered. If we are to teach these necessary fundamentals we should practice them in the construction of our shop equipment.

One of the advantages of this type of cabinet is the ease with which tools may be checked. It is well to have only enough racks for the tools actually in the shop. In this way, a vacant place is most readily noticed, and the missing tool designated.

Provide a definite place for everything in the shop, and with a little patience and persistence you will find them in their places, when not in use.

We do not paint the outlines of the tools on our boards as it mars the appearance of the rack. We depend upon the student noticing the place from which he takes a tool, and putting it there when he returns it.

Boys in the shop are like to any other persons — they notice and appreciate nice things and can very easily be encouraged to fully co-operate in the maintenance of the shop and its equipment, if properly planned.

The material from which this cabinet is to be made depends on the other equipment and primarily on the trim of the shop. The one illustrated was constructed of chestnut and fir plywood, the chestnut being stained and filled dark oak, and the paneling finished natural color, all being finally given two coats of dull varnish.

The back was built in solid with 1 by 6-in. tongue-and-groove white pine and covered with ¼-in. fir paneling. This produced a very rigid foundation for the entire cabinet as well as the tool racks and clamps. If possible, try to obtain one piece of paneling to cover the entire back, then run a piece of ¾-in. quarter round around all four edges, as a finish. It is not necessary to nail the panel in the center, as the racks and clamps will securely fasten it to the pine backing.

The center racks for the automatic screw drivers are made of 5/4-in. pine securely fastened with flat-head wood screws, and then faced with the fir paneling. The holes are of course spaced evenly, and bored to a uniform depth.

The other racks are all made of chestnut, and fastened with round-head brass wood screws. All holes for tools should be well countersunk on the top, so that the tools will slip into the holes quite readily.

Most tools are held by sturdy, brass-shouldered, square screw hooks.

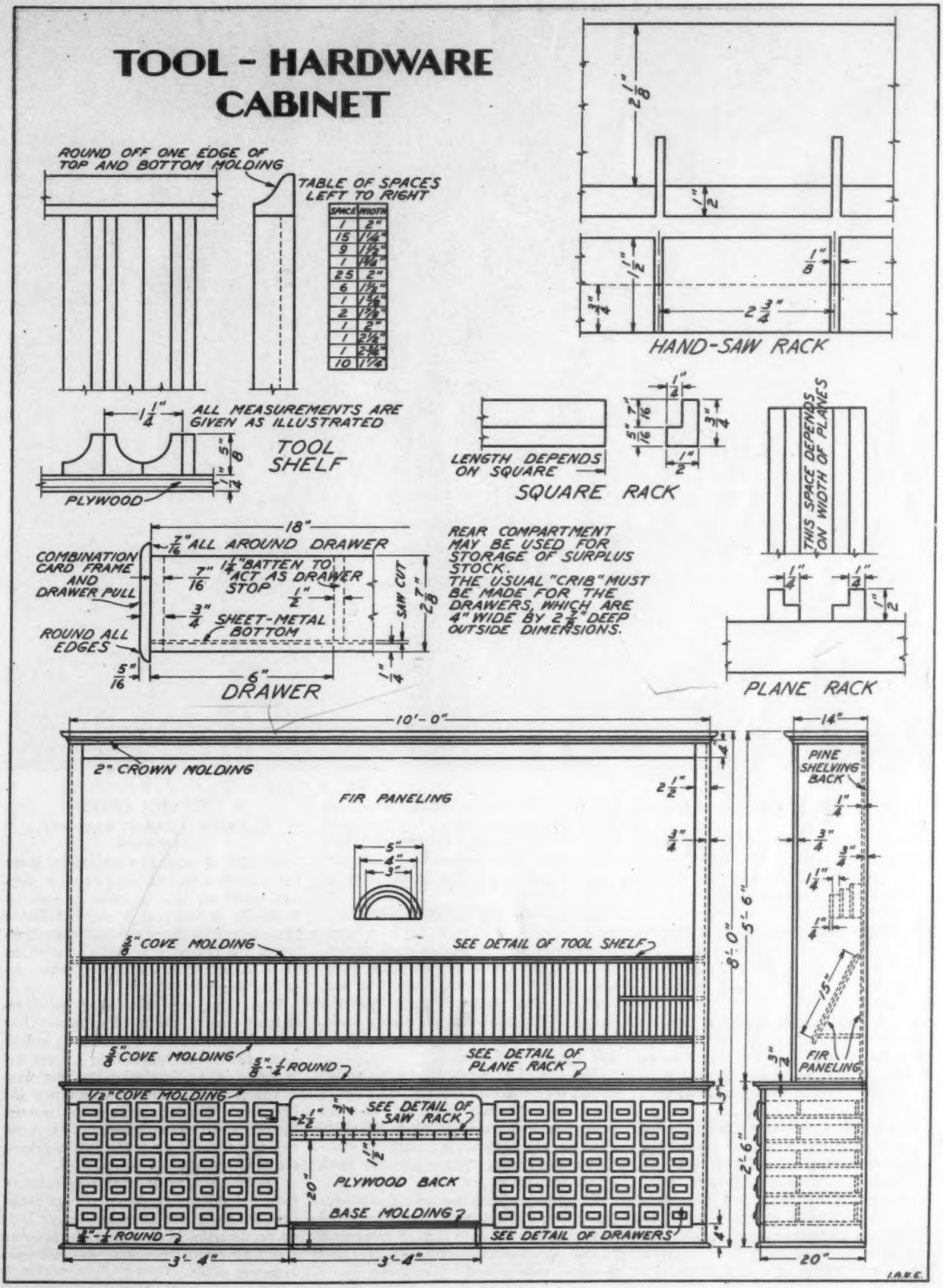
The points of the compass saws rest on a piece of ⅜-in. dowel.

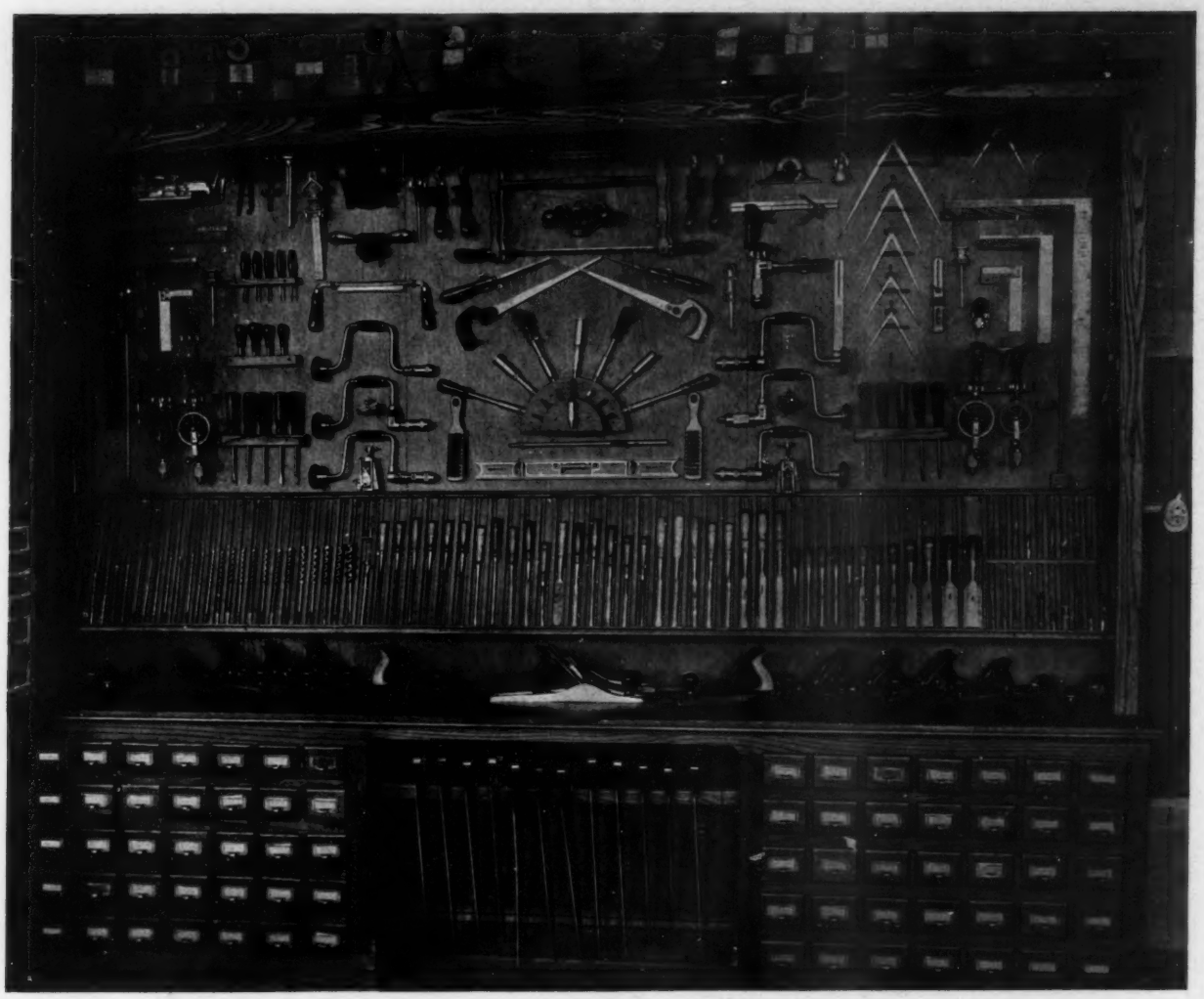
The dividers are held by small triangular blocks of ¾-in. chestnut, the top point being cut to fit the circular part of the hinge.

The hand drills and some of the other tools are held with a regular tool clamp, blocked out on chestnut so as to clear the knots.

The planes are placed in a set of "tracks" which keep the bed off the counter and thus protect the cutting edges. They are also placed on an angle, to make them

TOOL - HARDWARE CABINET





handy and also to help the general appearance of the cabinet.

The saw rack is made of ¾-in. oak, and faced with chestnut.

The drawer construction is quite unique. For two reasons, they are made very long; first, to prevent the drawer from "dropping" when pulled out, and secondly, to provide storage space for hardware.

The surplus of the hardware placed in the drawer (front) section may be kept in the storage section (rear). A turn button to act as a stop is placed on the partition so that only the "active" stock is seen when the drawer is pulled out by the student. The button must be turned to give access to the storage compartment in the rear.

The right-hand section of drawers is used for nails, brads, rivets, washers, bolts, tacks, escutcheon pins, etc., while most of the left-hand section is used for flat- and round-head screws. The name cards should be covered with a piece of celluloid for protection and preservation.

A small can of oil (3 in 1 or similar) is always kept handy in the cabinet, and is used for the lubrication and rust prevention of the tools. Once a month a boy is assigned to go over all the tools, to tighten and check all parts, as well as to rub their entire surface with the oil. This keeps them in splendid condition.

The object of this cabinet is to hold only the so-called "special tools," as each bench is equipped with a shallow tool drawer, partitioned to hold a smooth plane, backsaw, ½- and 1-in. chisels, 1- and 2-ft. steel rules, try-square, marking gauge, hammer, coping saw, and pencil. A bench hook, brush, and mallet are hung from the under side of each bench top.

The size of this cabinet can be varied to suit the particular needs of any shop. A set of four showcase lights were installed in the top, with a snap switch on the right-hand side. This lighting is remarkably effective, and, of course, is not generally used, except for display purposes.

The tool arrangement will depend entirely upon the tools which are to be placed in the cabinet. Strive to keep its appearance "balanced." Be sure that all tools are easily procured and replaced.

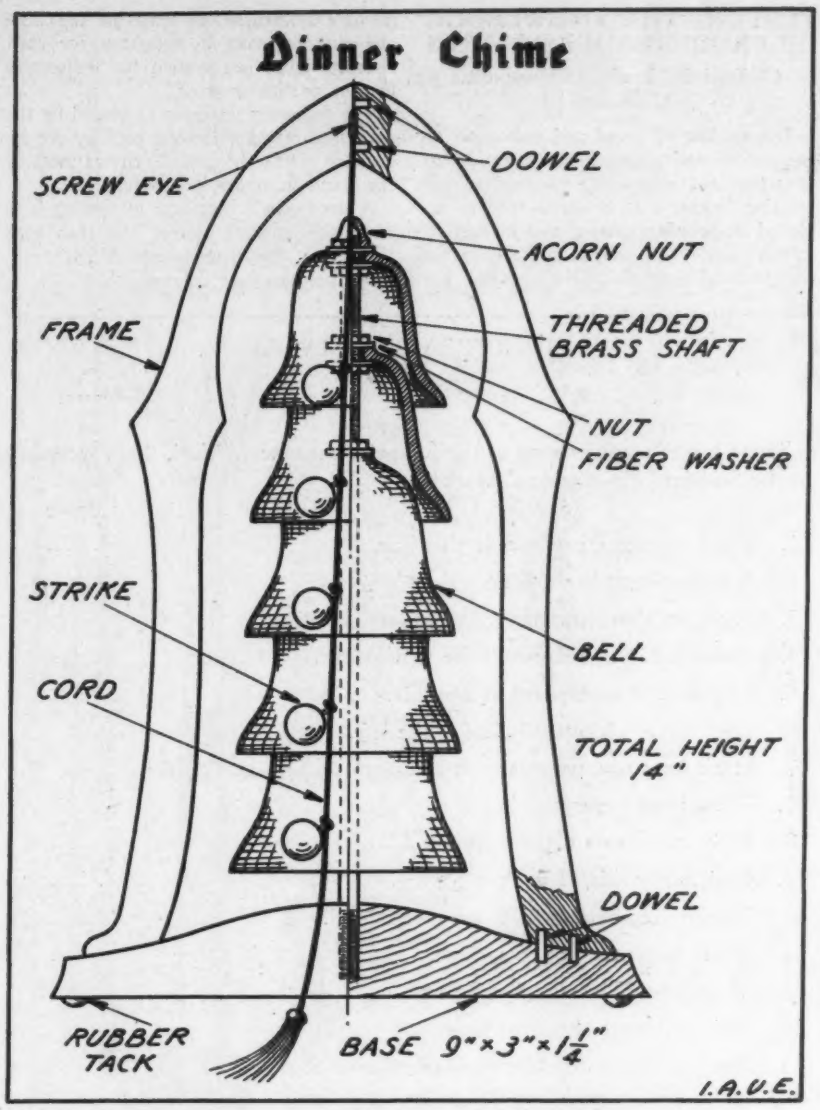
A DINNER CHIME

E. LeRoy Longley, Baltimore, Maryland

The idea of reclaiming old articles about the home and turning them or their parts into something that is useful is enticing. Especially is this true if the new article bears with it some of the sentiment clinging to the things from which it is made. Such an article is the dinner chime described herewith.

First came the bells which were reclaimed from a discarded carillon. Their musical-scale order is C, D, E, F, and G. These bells were mounted on a brass rod as shown in the illustration and they were locked in place between felt washers and brass nuts. The bells were made to overlap slightly to cover the sight of the brass rod, also to keep the project from gaining too much height.

The base was made from wood salvaged from an old square piano. It was found that the wood was rosewood veneer built up on beautiful black walnut. In order to give interest to the design, the Moroccan arch was added.



Instead of using the ordinary mallet or hammer for striking the gong, a cord was fastened to the top of the arch and metal buttons that had at one time graced a dress worn by the writer's mother were tied to it at appropriate distances. When the cord is picked up and then allowed to fall, the buttons ring the bells.

THE MORTISE-AND-TENON JOINT — VI

John E. Doren, Eureka High School, Eureka, California

(Continued from page 32, January, 1936)

Tenon Process

Lay out the tenon. Mark shoulder lines with a properly sharpened pencil, and mark cheek lines with marking gauge. The gauge should be set twice for marking the cheek lines, and all the gauging should be done from the working face. See Figure 29.

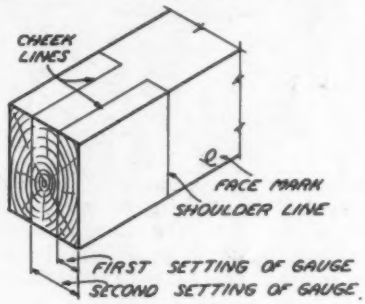


FIG. 29

To avoid mistakes, it is well to place "X" marks on all parts to be cut away.

A. To Cut Tenons by Hand

When tenons are cut with hand tools, it is good practice to cut the cheeks first with a fine-tooth, fast-cutting ripsaw that has been side-dressed to cut smoothly. The ripping should stop at the shoulder line as shown in Figure 30.

The shoulder cuts should be made with a sharp crosscut saw, and it is essential that

FOR YOUR BULLETIN BOARD

POSTER 71 **APRIL, 1936**

SYMPATHY

Sympathy depends partly on seeing the other person's viewpoint. Industrial arts provides an opportunity to learn to sympathize with those who make things, and to appreciate what their work requires.

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Submitted by Professor L. M. Roehl, Cornell University, Ithaca, New York

the shoulder cuts shall positively stop at the cheek lines. See Figure 31. Even a slight cut into the tenon at the shoulder will greatly reduce the strength of the tenon.

One must keep in mind that the saw has thickness and that all cutting should be in the waste wood; namely, the part that is to be cut away. The sawing should be close

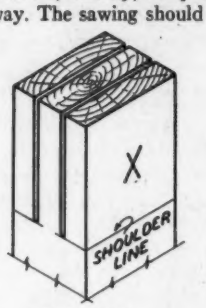

FIG. 30

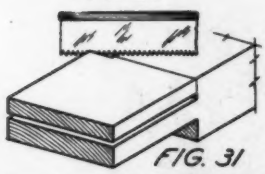

FIG. 31

to the line but the line must not be destroyed. If the sawing is well done, the line will be visible when the cutting is finished, and there will be no surplus wood between the sawcut and the line to be removed later.

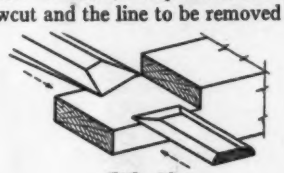

FIG. 32

If, after ripping the cheeks, the tenon is found to be in need of slight trimming, this trimming may be done with a wide chisel. The cutting must be across the grain of the wood and from both edges toward the center as shown in Figure 32.

(To be continued)

TESTING THE KNOWLEDGE OF PROOFREADERS' MARKS

Clifford K. Lush, Minneapolis, Minnesota

The reading of proof and indication of the errors and changes necessary is an operation not necessarily confined to the printing industry. It is almost always included in printing courses and in English composition. The marks are somewhat standardized throughout the country, but the few differentiations made by the various authors make it necessary for each class to adopt one system for uniformity in that particular group.

The following test may be scored by the particular marking method used by the instructor giving the test. It covers most of the common errors in proofs.

A very satisfactory way of scoring is to mark the number correct and then rank the scores. The percentage of A's, B's, etc., may then easily be determined.

PROOFREADERS' MARKS

Score------

There is one error in each of the following sentences. Mark them according to the Standard Proofreaders' Marks.

		Score
1.	There is a defective letter in this line.	------
2.	A space shows in this line.	-- ---
3.	Mark out the extraa letter in this line.	------
4.	One letter in this line is of the wrong font.	------
5.	One word is transposed in line this.	------
6.	Move this line to the left.	------
7.	Mark for a new paragraph at end of this sentence. Thanks.	------
8.	There is no paragraph here.	------
9.	Begin minnesota with a capital.	------
10.	Omit the words, I can't.	------
11.	The spacing here should be equalized.	------
12.	There is too much space here.	------
13.	There should be no space be tween.	------
14.	Find and mark the error heie.	------
15.	Yes. Use an en quad between sentences.	------
16.	Mark for small caps in the word mark.	------

FOR YOUR BULLETIN BOARD

POSTER 72 **APRIL, 1936**

COURTESY

Courtesy is practiced by folks of strong personality. In shops where tools and materials are used by the group, there is good opportunity for the practice and development of courtesy.

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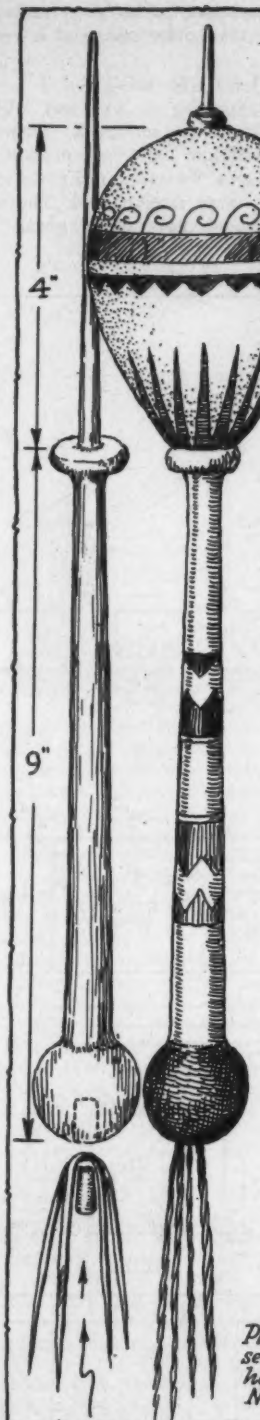
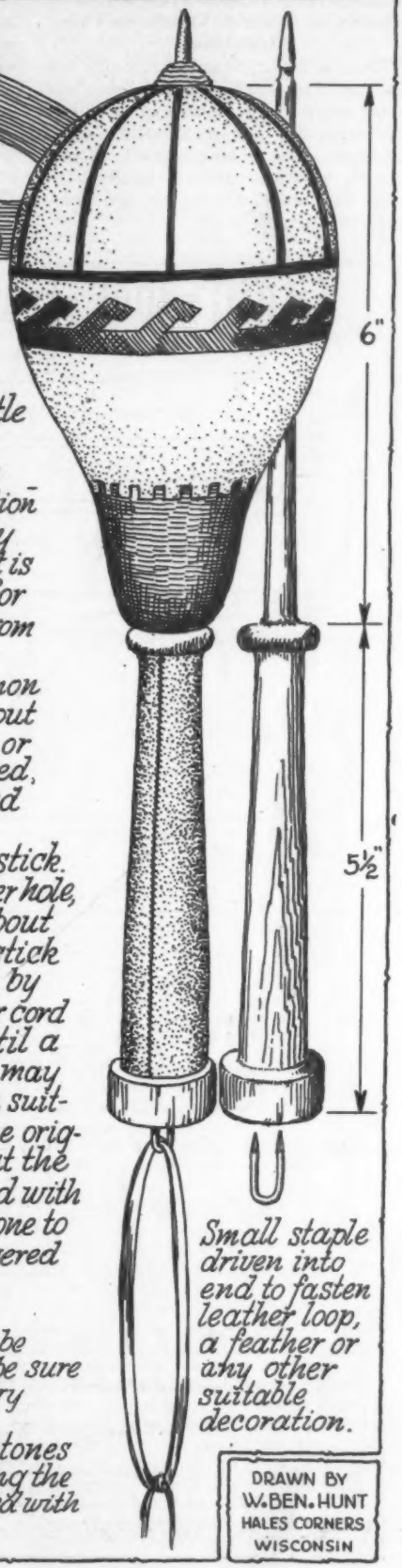
Submitted by Professor L. M. Rochl, Cornell University, Ithaca, New York

INDIAN GOURD RATTLES





Rattles made almost as much of the dance "music" of the American Indian as the tom-tom. They were made of turtle shells, rawhide and gourds: While easier to obtain, gourds are also more adaptable to ornamentation. The gourd at the left is commonly called the nest egg gourd, and as it is pure white when dried, it is ideal for decorating with paint. They are from 3 to 4 inches long.

The gourd at the right is the common green-striped variety which dries out to a light yellow. A coat of cream or white-colored paint may be applied, and the designs or symbols painted on over that.

Cut a hole in each end to fit the stick. Take out the dried seeds thru the larger hole, and put in 5 or 6 round stones about ¼" in diameter. Then insert the stick and fasten it at the upper end by wrapping a thin strip of leather or cord set in glue around the stick until a knob is formed. The handles may be painted with suitable designs. The original of the one at the left was covered with beads while the one to the right was covered with buckskin.

Plant some mixed gourd seed early in spring and have dried gourds by New Years.

A quarter-inch hole drilled in end of handle, into which a wooden plug is driven to fasten a few thin strips of buckskin

Note: *Any dry wood may be used for the handle and be sure the gourds are perfectly dry before using them. Don't forget to put in the stones or BB shot before fastening the stick. Seeds can be loosened with a piece of wire.*

Small staple driven into end to fasten leather loop, a feather or any other suitable decoration.

DRAWN BY
W. BEN. HUNT
HALES CORNERS
WISCONSIN

BENCH TOOL HOLDER

Gerald L. Waltrip, Oklahoma City, Oklahoma

The tool holder described herewith was designed to be used on a double bench, and it has proved very valuable in several of the Oklahoma City woodworking shops. Below are listed its advantages.

1. It holds in a uniform manner those tools which are used most, and each tool is protected from the other.

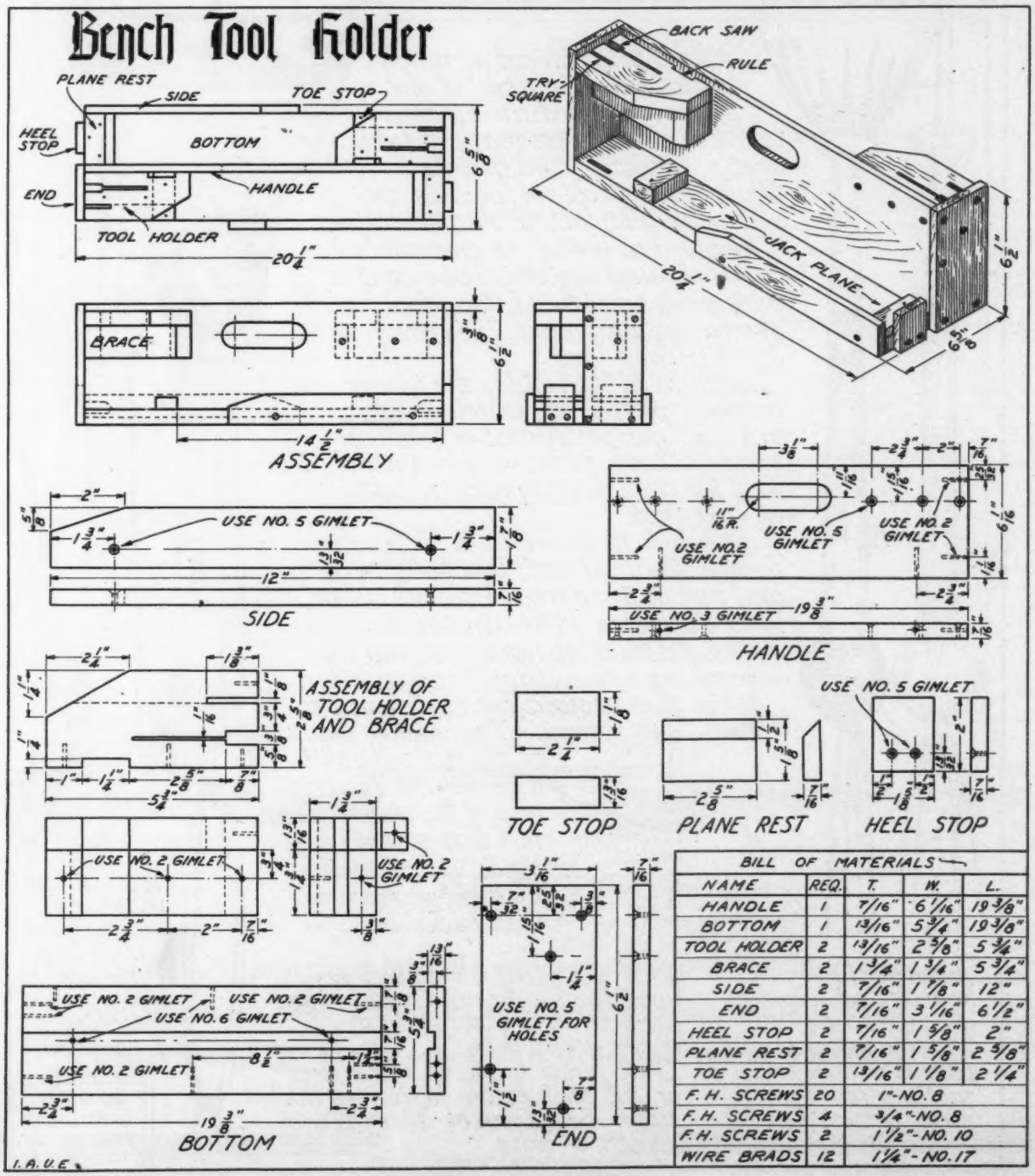
2. The workbench can be easily cleared, making more room for assembly of larger problems, unobstructed view for demonstrations, etc.

3. The instructor can easily check every bench and its equipment in a very short time because of the uniformity and arrangement of the tools.

The writer made his tool holders of oak and applied two coats of shellac. They have been in use for almost four years and have not shown much wear. Other shop teachers who now use this holder commend it very highly.

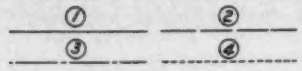
PLEASE NOTE

The cuts appearing in XVI and XVII on page 77 under the section K "Dimensions" in the March, 1936, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION unfortunately were interchanged. The information should have been given as follows:



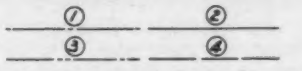
BILL OF MATERIALS				
NAME	REQ.	T.	W.	L.
HANDLE	1	7/16"	6 1/16"	19 3/8"
BOTTOM	1	13/16"	5 3/4"	19 3/8"
TOOL HOLDER	2	13/16"	2 5/8"	5 3/4"
BRACE	2	1 3/4"	1 3/4"	5 3/4"
SIDE	2	7/16"	1 7/8"	12"
END	2	7/16"	3 1/16"	6 1/2"
HEEL STOP	2	7/16"	1 5/8"	2"
PLANE REST	2	7/16"	1 5/8"	2 3/8"
TOE STOP	2	13/16"	1 1/8"	2 1/4"
F. H. SCREWS	20	1"-NO. 8		
F. H. SCREWS	4	3/4"-NO. 8		
F. H. SCREWS	2	1 1/2"-NO. 10		
WIRE BRADS	12	1 1/4"-NO. 17		

XVI. The form of dimension line used is that shown at:



Response	*No.*	*Per Cent*
1	108	94
2	1	1
3	5	4
1–2–3	1	1
None	3	

XVII. The form of center line used is that shown at:



Response	*No.*	*Per Cent*
1	93	80
2	5	4
3	8	7
4	1	1
1–2	4	4
1–3	3	3
1–3–4	1	1
None	3	

Personal News

Miss Florence Fallgatter has been appointed as chief of the home-economics education service of the home-economics division, United States Office of Education. Miss Fallgatter, who has been a member of the home-economics staff for a number of years, had previously been associated with the universities of Minnesota, Missouri, and Tennessee, and with the State College of Montana. She was also a regional agent with the home-economics division of the Federal Board.

Miss Jane Rehnstrand, art instructor at the State Teachers' College, Superior, Wis., has been assigned as editor of the February issue of the *School Arts Magazine*, published by Pedro J. Lemos.

Mr. Fred O. Armstrong has been appointed head of the industrial-arts department at the State Teachers' College, Trenton, N. J. He succeeds Mr. Charles A. Burt, who has retired after the completion of forty years of service.

Mr. James J. Crawford, of the State Teachers' College, California, Pa., has gone to Trenton, N. J., where he has taken the position of assistant to Mr. Fred O. Armstrong at the State Teachers' College.

Mr. Fred Erhard has been appointed state supervisor of apprentices for the Texas State Department of Education.

Mr. J. R. D. Eddy has become district state supervisor of industrial education at Dallas, Tex.

Mr. J. J. Lancaster has become director of industrial arts at Pasadena, Tex.

Mr. H. K. Dodges has been appointed director of industrial arts at Temple, Tex.

Dr. L. A. Emerson, of Scarsdale, N. Y., has been appointed assistant superintendent in charge of vocational education for the Saunders Trade School at Yonkers, N. Y.

Supt. E. A. T. Hapgood, of Mount Morris, N. Y., was recently re-elected to his position, at an increase in salary. Mr. Hapgood was formerly director of vocational education and principal of the industrial high school at Albany, N. Y.

Association News

WESTERN ARTS ASSOCIATION CONVENTION

The combined meeting of the Western Arts and Southeastern Arts Associations will be held in Nashville, Tenn., April 1 to 4, 1936. The Hermitage Hotel will be the headquarters. It is expected that a record-breaking attendance will be achieved.

The educational and commercial exhibits will be housed in the Hermitage and Andrew Jackson Hotels, and in the War Memorial Building. Mrs. Wanda L. Wheeler, President of the Southeastern Arts Association, and Mr. Frank C. Moore, president of the Western Arts Association, will be co-chairmen at all general meetings. The registration will take place at 9:30 a.m., Wednesday, April 1. Wednesday afternoon will be taken up by sectional meetings in art, home economics and industrial arts. At 8 p.m. will be held the first general meeting at which the presidents of the two organizations will give their annual messages.

Dr. Harry Clark, Superintendent of Schools, Knoxville, Tenn., will be the main speaker. The annual Ship's party will be held after the meeting in the main dining room of the Hermitage Hotel.

Thursday morning will again be taken up by sectional meetings. Art teachers will find the topic of "Marionettes and Puppets as a Hobby and a Craft" exceedingly interesting. Home-economics teachers will at this time discuss textile designs, costume designs, and cookery, while the industrial-arts teachers will have an opportunity to hear Dr. Wm. E. Warner on "Industrial Arts in Smaller School Systems," Frank C. Moore on "Elementary Handcraft," and Elmer W. Christy on "Co-operative Activity Program." Thursday afternoon will be devoted to tours of various educational and other institutions. At the general session in the evening under the co-chairmanship of the vice-presidents of the Western Arts and Southeastern Arts Associations, the topic of "The Arts in Relation to Individuals within the Social Group" will be discussed.

Friday morning, art teachers will discuss the relationship between art and home-economics education, while the industrial-arts teachers will take up the general subject of utilitarian drawing. At this meeting, G. H. Hargitt, will speak on "Home Planning," Harry Wood on "Design," and E. A. Hauenstein on "General Drawing."

On Friday afternoon there will be a joint meeting of the teachers of art, home economics, and industrial arts. The general topic for this meeting will be "The Place of the Arts in the Curriculum of the Schools."

At the banquet Friday evening, Willis E. Sutton, Superintendent of Public Schools, Atlanta, Ga., will be the main speaker. The business meeting of the two associations will be held Saturday morning and the final general session will take place in the auditorium of the War Memorial Building, 9:35 to 11 a.m. At this time the speakers will be Dr. Thomas Munro, Educational Director of the Cleveland Museum of Art, and James A. Humberstone, Director, The Artisan Guild, Detroit, and Staff Member of the Edison Institute and Greenfield Village, Dearborn, Mich.

Some of the speakers to be heard on the various programs are: Joseph Alberts, Art Department, Black Mountain College, N. C. (formerly of the Bauhaus, Dessau, Germany); Carl Bolander, Columbus, Ohio; Margaret Browder, State Superintendent of Home Economics, Nashville, Tenn.; Blanche Cahoon, Director Art Education, Hillsborough County, Tampa, Fla.; Mrs. Mary Polson Charlton, School of Home Economics, University of Tennessee, Knoxville, Tenn.; Elmer W. Christy, Director Industrial Arts, Cincinnati, Ohio; George S. Dutch, Peabody College, Nashville, Tenn.; L. L. Gore, Peabody College, Nashville, Tenn.; Mrs. Mary Ed. Hall, Murray State Teachers College, Murray, Ky.; G. H. Hargitt, Supervisor Industrial Arts, St. Louis, Mo.; E. A. Hauenstein, Supervisor Industrial Arts, Lima, Ohio; Mrs. A. R. Jessup, Watkins Institute, Nashville, Tenn.; C. D. Knudsen, Professor of Secondary Education, Peabody College, Nashville, Tenn.; Rosabelle MacDonald, Director of Art, Roosevelt High School, New York City; Bess Foster Mather; Governor Hill McAlister, Nashville, Tenn.; Frank C. Moore, Superintendent of Industrial Arts, Cleveland, Ohio, President, Western Arts Association; Thomas Munro, Educational Director, Cleveland Museum of Art, Cleveland, Ohio; Hugh Newman, Chicago Academy of Art, Chicago, Ill.; Thomas C. Parker, Regional Director for the Arts, Southern States Federal Works Administration, Washington, D. C.; Felix Payant; Alfred G. Pelikan, Director of Arts, Public Schools and the Art Institute, Milwaukee, Wis.; Maris M. Proffitt, Educational Consultant, U. S. Office of Education, Washington, D. C.; Elizabeth Robertson; Elizabeth Slocumb, Art Department, State Teachers College, Johnson City, Tenn.; Grace Sobotka, Peabody College, Nashville, Tenn.; Dr. Macie Soothall; H. F. Srygley, Superintendent of Schools, Nashville, Tenn.; Willis B. Sutton, Superintendent of Public Schools, Atlanta, Georgia; Dr. Wm. E. Warner, Department of Practical Arts, Ohio State University, Columbus, Ohio; Jane Betsey Welling, Associate Professor of Art Education, Wayne University, Detroit, Vice-President, Western Arts Association; Harry Wood, Supervisor of Industrial Arts, Indianapolis, Ind., Secretary, Western Arts Association; Dr. Caroline B. Zachery.

EASTERN ARTS ASSOCIATION CONVENTION

The officers of the Eastern Arts Association have issued a preliminary announcement concerning the forthcoming meeting of the Association, to be held April 15 to 18, in New York City. The headquarters will be in the Pennsylvania Hotel.

The Eastern Arts Association has been a leading organization in the promotion of art education within its territory for many years, and has co-operated with the other organizations of this character in the Middle West, South, and Far West.

The officers have announced a fine program for the four full days of the meeting. The program offers material of an informative, stimulating, and interesting character. Leading art educators and superintendents of schools interested in art teaching will be among the speakers. Well-known creative artists also have been placed on the program. New types of exhibits will show achievements in progressive practice in cities all over the country.

New York City offers a number of fine opportunities as a convention city, with its outstanding examples of architecture, its art col-

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(Continued from page 133)

lections, and its outstanding offerings to those interested in art and art teaching. New York City also has numerous fine schools which offer opportunities for the study of art.

It is anticipated by the officers that this annual meeting of the Association will surpass that of any previous gathering of like character. An unusually large attendance is expected. The topics for discussion will center around the subject of Art for Everyday Life of Modern Times.

Information concerning the program and the speakers may be obtained by writing to Mr. Raymond P. Ensign, secretary of the Association, 333 East 43rd St., New York City.

CENTRAL CONNECTICUT INDUSTRIAL-ARTS ASSOCIATION MEETS

The annual meeting of the Central Connecticut Industrial-Arts Association was held January 29, at the Lincoln Junior High School, West Hartford. About fifty members were present.

President William F. Moran, of Waterbury, opened the meeting. Chairman Eugene Giammatteo, of Bristol, then introduced Mr. Donald B. Swett, principal of the school, who welcomed the visiting teachers and spoke of the work that can be done by industrial-arts teachers.

Judge Harry Schwolsky, of the Hartford police court, speaking on the subject, "Industrial Arts an Antidote for Juvenile Delinquency and a Preventive of Adult Delinquency," pointed out that industrial arts is a great medium for inducing boys to acquire hobbies, which will help them make valuable use of their leisure.

Mr. Sidney E. Cornelius, manager of the Hartford County Manufacturers' Association, speaking on "Trends in Manufacture," predicted that a return of business to normal would witness a shortage of skilled mechanics. He said he would be glad to co-operate with anyone wishing to take a class through the manufacturing plants.

Mr. Burgess, of the *Popular Mechanics Magazine,* described the efforts of his company in the direction of improving the magazine so that it will better fit the needs of boys.

At the business meeting a report was given by Mr. Cave, of New Haven, on the New England Industrial-Arts Teachers' Association. A report on the progress of the state conference was made by Mr. Houdlette.

The new officers elected are: President, Eugene Giammatteo; first vice-president, James H. Ginns; second vice-president, Samuel B. Bassett; treasurer, Thomas E. Pascoe; secretary, Harry A. Barnicle. —*Harry A. Barnicle.*

BERGEN COUNTY INDUSTRIAL-ARTS CLUB MEETS

The Bergen County Industrial-Arts Club of New Jersey held its regular meeting on February 17, in the New Milford Junior High School at New Milford, N. J. The Club, an organization of industrial-arts instructors from Bergen County and the vicinity, completed its yearly course under the supervision of Mr. Robert A. Campbell, supervisor of industrial education for the State of New Jersey.

The guest speaker of the evening was Mr. Karl Ritter, principal of the Tenafly High School, Tenafly, N. J., who took for his subject, "Character Building in Our Schoolwork."

At this meeting, a publicity committee was appointed, consisting of Mr. Charles Goodyear, of East Rutherford; Walter M. Dunn, of Dumont; and C. L. Geyer, of Lodi. Mr. Ralph Knettle was named as an official delegate to the Asbury Park convention of the New Jersey Vocational Association.

The Association voted to hold the next meeting on April 6, in the New Milford Junior High School. At that meeting there will be a talk, an exhibit of school camera clubs, and a demonstration and exhibit of metal spinning.

The following officers were elected for the year: President, Mr. Howard L. Barrett, New Milford, N. J.; vice-president, Mr. John Steenstra, Paterson; secretary, Mr. Francis McMaster, Ridgewood; treasurer, Mr. Edward T. Smith, Glenrock. — *Walter M. Dunn.*

SOUTH DAKOTA VOCATIONAL ASSOCIATION MEETS

The South Dakota Vocational Association held its annual luncheon and meeting in connection with the regular state education association in November last. Mr. W. R. Ronald, chairman of the state planning board, gave a talk on the work of the board, which was followed by a discussion of possible plans for utilizing the work of the committee for the promotion of vocational education. It was voted to appoint a committee to work with the planning board in determining the needs of the state and in making recommendations for improvements. The committee, headed by Mr. W. P. Beard, director of vocational agriculture, desires to undertake a survey, to obtain information governing the development of courses in the high schools and to determine the needs and trends for out-of-school boys and girls of the state. The principal speakers were Mr. I. D. Weeks and Miss Agnes Samuelson, president of the N. E. A.

The Association has had a very successful growth since its organization three years ago. Its present membership is 84.—*Orlan P. Cook.*

ST. PAUL MANUAL-ARTS ASSOCIATION CELEBRATES SILVER JUBILEE

The Manual-Arts Association of St. Paul, Minn., held a banquet in the Ryan Hotel, on Monday, February 3, in honor of its twenty-fifth year of organization. There are eight charter members

Mr. George M. Brace, president of the Association, presided, and Mr. L. R. Harnsberger, vice-president, gave the historical highlights. Both Mr. Brace and Mr. Harsberger have served in the same capacity since the beginning of the organization in February, 1911. Mr. H. W. Schmidt, of the State Education Department, Madison, Wis., gave a short résumé of early problems and added personal touches. — *Court E. Sanders.*

NEW YORK STATE BRANCH OF PROGRESSIVE EDUCATION ASSOCIATION MEETS

The regional conference of the New York State Branch of the Progressive Education Association will be held on Friday and Saturday, May 8 and 9, in Buffalo.

Plans have been made by the officers of the Association to enlarge the scope of the Conference and the geographical area to be served, following the remarkable success of the last conference in Buffalo. More than 200 Canadian members are planning to attend. Nonmembers, as well as members, will be welcomed at all conference sections. Plans are being made to welcome more than 2,000 visiting schoolmen at the 1936 meeting, and each local community is urged to send its representative to this meeting.

Information concerning the program and the speakers can be obtained by writing to Dr. Robert Thompson, chairman of the program, at the State Normal School, Fredonia, N. Y.

New Publications

Hand Loom Weaving for Amateurs

By Kate Van Cleve. Cloth, 5¼ by 7⅝, 122 pages, illustrated. Price, $1.

Leathercraft for Amateurs

By Eleonore E. Bang. Cloth, 5¼ by 7⅝, 114 pages, illustrated. Price, $1.

Metalcraft for Amateurs

By Peter Manzoni. Cloth, 5¼ by 7⅝, 136 pages, illustrated. Price, $1.

The three books just enumerated belong to a set of manuals published by the Beacon Press, Inc., Boston, Mass., for the purpose of providing pleasurable avocations and the foundational instruction necessary to continue the work beyond the realm of artcraft work.

The manual on weaving will be found helpful by the beginner. It is concisely but plainly written and explains a number of useful things to the beginner in weaving. The glossary explains the meaning of the trade terms encountered in the book.

The manual on metal craft covers the work with sheet metals and alloys, embossing and chasing, forming, planishing, and fluting, etching, enameling, soldering, riveting, and finishing. The book contains a number of very interesting projects.

The one on leathercraft describes the use of the tools and gives step-by-step directions for making a number of useful projects illustrated in the book.

Electricity in the Home and on the Farm

By Forrest B. Wright, Ph.D. Cloth, 5¾ by 8¼, 320 pages, illustrated. Price, $2.50. Published by John Wiley & Sons, Inc., New York City.

A book written for the student at school as well as for the householder and farmer. It covers the practical information necessary for an understanding of d.c. and a.c. currents and illustrates and explains the installation and care of the ordinary electrical appliances.

The Flat Bow

By W. Ben. Hunt and John J. Metz. Paper, 6 by 8, 64 pages, illustrated. Price, 50 cents. Published by The Bruce Publishing Company, Milwaukee, Wis.

This book, devoted exclusively to the flat bow, will be of interest to the beginner in industrial arts and vocational education. It contains easy-to-follow directions on the making of bows, bowstrings, arrows, and archery tackle. The book is well illustrated.

Tests and Measurements in Industrial Education

By Louis V. Newkirk, Ph.D., and Harry A. Greene, Ph.D. Cloth, 6 by 9¼, 253 pages, illustrated. Price, $2.75. Published by John Wiley & Sons, Inc., New York City.

The book points out the need for the right kind of testing in the school shop. It ought to be in the library of every shop teacher. It

(Continued on page 11A)

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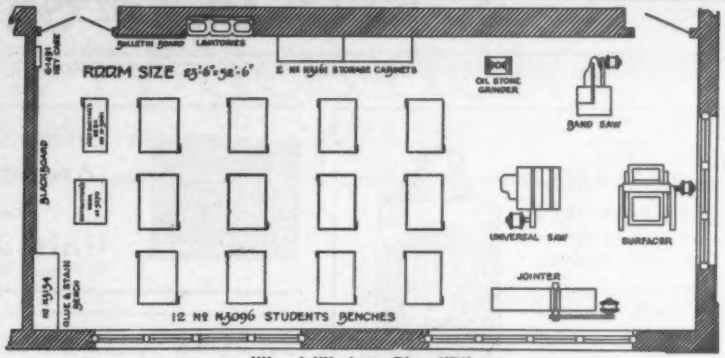

Wood Working Plan "B"

Glue and Stain Bench No. N-3154

Single Manual Training Bench No. N-3088

Drawing Table No. BL-94

Metal Worker's Table No. N-3151

(Continued from page 134)

is quite comprehensive and the explanations and definitions are given so that they are easily understood. Even the mathematics of testing is explained so that no shop teacher need be afraid of it.

Financial Organization and Management of Trade and Industrial Schools

By John B. Coleman and William F. Oppermann. Paper, 8½ by 11, 315 mimeographed pages, illustrated. Published by the La Crosse Vocational Publishing Company, La Crosse, Wis.

An exhaustive and detailed account of the financial organization and management of trade and industrial schools. It is not merely a theoretical dissertation but a lucid explanation of a practical plan that has been thoroughly tested at the La Crosse Vocational School. The making of the budget, the various forms required, inventory keeping, etc., are all described and illustrated.

Modern Radio Essentials

By Kenneth A. Hathaway. Cloth, 5¾ by 8½, 200 pages, illustrated. Price, $2. Published by The American Technical Society, Chicago, Ill.

This book covers the fundamental principles of radio. It is intended as a text for radio classes in high schools, technical schools, and vocational schools. Besides the explanations of the elementary rules and phenomena of magnetism and electricity, the book describes vacuum tubes, oscillatory circuits, amplification, receiving circuits, reproducing devices, power supply, etc.

The appendix contains a table for calculations of resonant circuits.

School-Shop Equipment News

SHEBEL CRAFTSMAN'S SAW FILER

A. P. Shebel, 730 South Second St., Milwaukee, Wis., has perfected the new Craftsman's Saw Filer. It is made of steel throughout, and is of strong and durable construction. With it, an inexperienced person can quickly learn to file any type of hand, band, or circular saw that can be sharpened with a triangular file. The filer is plated to make it rustproof.

The inventor of this saw filer also has written a booklet *The Art of Saw Filing*. This is accompanied by a filing model which clarifies the text. The extremely low price charged for the booklet makes it ideal as a reference book on saw filing, and the low cost of the Craftsman Saw Filer puts it well within the reach of any school shop.

THE YATES-AMERICAN W-20 LATHE

The Yates-American Machine Company, Beloit, Wis., is marketing its W-20 lathe as a part of the new line of small woodworking machines which this firm is now building for home, school, and light industrial use.

This precision-built lathe embodies in its design the many years of Yates-American lathe-building experience. Besides beauty of line, it has an exceedingly rigid construction, giving it the freedom from vibration so essential to fine wood turning.

The W-20 lathe has a swing capacity of 14 in. over its entire bed. The standard lathe can handle work 31 in. between centers, although beds can be furnished to handle additional lengths. The headstock is designed to permit the use of a wide variety of accessories. It is also equipped with an indexing device. A built-in spindle lock permits the easy changing of faceplates and accessories.

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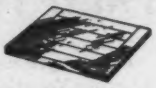

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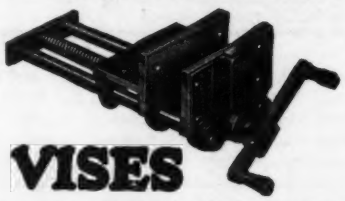

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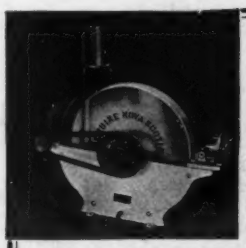

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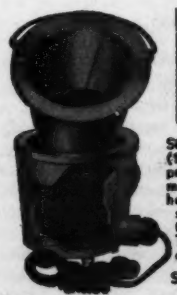

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REQUISITION TIME

The time for ordering tools, supplies, and equipment is here again. The things requisitioned may not be needed at once, but it is always well to have long-range plans rather than to place orders only when the needs of the moment make it imperative. Deliveries that have to be made under pressure frequently are incomplete, thus causing further delay, dissatisfaction, and additional expense. This is the time, then, to study future needs properly, to requisition the things required, and then to see that their delivery be not unduly hastened.

OF SPECIAL INTEREST

The attention of our readers is directed to the study made by Betts and Van Duzee on the relationship of interest to learning. As frequently happens, commonly accepted opinions are disproved by studies of this kind.

The article "Thoughts for this Year's Graduates" by Hobbs is particularly timely, as is also Pawelek's article on grading the student's work.

THIS MONTH'S COVER

The picture chosen for this month's cover shows the section of the Automotive High School, Cincinnati, Ohio, in which airplane motors are studied. The photograph was obtained from Mr. Nelson L. Burbank of the Building Vocational High School through the courtesy of Mr. J. F. Arundel, Director Vocational Education, Cincinnati, Ohio.

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